ONTARIO MINISTRY OF ENVIRONMENT
36936000023908

1969

OPERATING SUMMARY

OWRC
WATER POLLUTION CONTROL PLANTS

LIBRARY COPY
JAN 15 1971
ONTARIO WATER
RESOURCES COMMISSION

LABORATORY LIBRARY
ONTARIO WATER RESOURCES COMMISSION

TD
367
.A56
O97
1969
MOE

ONTARIO WATER RESOURCES COMMISSION

Division of Plant Operations

LABORATORY & RESEARCH LIBRARY
MINISTRY OF THE ENVIRONMENT

TD
367
.A56
O97
1969

Ontario Water Resources
Commission : water pollution
control plants.
81556

ONTARIO WATER RESOURCES COMMISSION

WATER POLLUTION CONTROL PLANTS

Prepared by the
Project Services Section,
Division of Plant Operations.

September, 1970.

Environment Ontario
Laboratory Library
125 Resources Rd.
Etobicoke, Ontario M9P 3V6
Canada

CONTENTS

List of Tables and Graphs ii
List of Plants included in Report iii
Introduction v
Plant Loading and Effluent Quality 1
Grit Removal 12
Primary Sedimentation 14
Secondary Treatment 16
Chlorination and Disinfection 18
Sludge Digestion 20
Vacuum Filtration 22
Material Balance 24
Operating Staff 26
Operating Costs 29

LIST OF TABLES

TABLE	DESCRIPTION	Page
I	Hydraulic Loading	3
II	Organic Loading	8
III	BOD and Suspended Solids Concentrations	9
IV-V	Nutrient Concentrations	10-11
VI	Primary Sedimentation	15
VII	Secondary Treatment	17
VIII	Chlorination and Disinfection	19
IX	Anaerobic Sludge Digestion	21
X	Vacuum Filter Operation	23
XI	Material Balance	25
XII	Operating Staff	27
XIII-XIV	Operating Costs	33-34
XV	Unit Operating Costs	35

LIST OF GRAPHS

GRAPH NO.	DESCRIPTION	Page
1	Hydraulic Loading	2
2-5	Loading and Effluent Quality	4-7
6	Grit Removal	13
7	Staff Complement	28
8	Total Operating Cost	31
9	Cost per Capita	32

Digitized by the Internet Archive
in 2015

https://archive.org/details/ontariowaterreso23908

PLANTS INCLUDED IN REPORT

	Project Number	Nominal Capacity (migd)	Receiving Waters
PRIMARY TREATMENT PLANTS			
1. Belleville	2-0084-61	3.0	Bay of Quinte
2. Cornwall	1-0001-66	8.25	St. Lawrence River
3. Espanola	2-0074-61	0.66	Spanish River
4. Fort Erie	2-0039-59	1.8	Niagara River
5. Fort Frances	2-0059-60	2.0	Rainy River
6. Midland	2-0146-63	1.25	Georgian Bay
7. Owen Sound	2-0068-60	3.0	Owen Sound
8. Parry Sound	2-0113-62	0.8	McCurry Lake
9. Point Edward	2-0036-59	0.57	St. Clair River
10. Port Dover	2-0115-62	2.0	Lake Erie
11. Sault Ste. Marie	2-0020-59	8.0	St. Mary's River
12. Thunder Bay North	2-0013-58	4.0	McIntyre River
13. Thunder Bay South	2-0091-61	6.0	Kam River
14. Timmins	2-0071-60	3.0	Mattagami River
15. Trenton	2-0004-57	1.0	Bay of Quinte
EXTENDED AERATION PLANTS			
16. Burlington Skyway	2-0105-62	6.0*	Hamilton Harbour
17. Elora	2-0125-62	0.08	Grand River
18. Moore Township	2-0088-61	0.32	St. Clair River
19. Moosonee	1-0004-66	0.075	Store Creek
20. Paris	2-0034-59	0.5	Grand River
21. Westminster Township	2-0033-59	0.25	Dingman Creek
CONTACT STABILIZATION PLANTS			
22. Haileybury	1-0069-67	0.35	Lake Timiskaming
CONVENTIONAL ACTIVATED SLUDGE PLANTS			
23. Brantford	2-0011-58	12.5	Grand River
24. Burlington Drury Lane	2-0051-60	2.5	Lake Ontario
25. Burlington Elizabeth Gardens	2-0028-58	0.75	Lake Ontario
26. Chatham	2-0102-62	4.5	Thames River
27. Coniston	2-0008-57	0.26(prim) 0.17(sec)	Coniston Creek
28. Elmira	2-0096-61	0.68	Canangagique Creek

	Project Number	Nominal Capacity (migd)	Receiving Waters
29. Fergus	2-0023-58	0.6	Grand River
30. Galt	2-0090-61	5.0	Grand River
31. Georgetown	2-0017-58	1.5	Silver Creek
32. Huntsville	2-0015-58	0.25	Muskoka River
33. Kingston Township	2-0098-61	0.8	Lake Ontario
34. Kitchener	2-0019-58	13.5	Grand River
35. Markham	2-0040-59	0.66	Exhibition Cr. (Rouge R.)
36. Nepean Township	2-0035-59	1.5	Watts Creek
37. Newmarket/E. Gwillimbury	2-0087-61	2.0	Holland River
38. North Bay	2-0010-58	4.0	Lake Nippissing
39. Orangeville	2-0016-58	0.75	Credit River
40. Pickering	1-0015-66	0.4	Duffin's Creek
41. Port Colborne East	**	0.85	Welland Canal
42. Port Colborne West	2-0047-59	0.9	Welland Canal
43. Preston	2-0046-59	1.8	Grand River
44. Richmond Hill	2-0006-57	1.6	German Mills Creek
45. Sidney Township	2-0121-62	0.12	Trent River
46. Simcoe	2-0120-62	2.0	Lynn River
South Peel:	1-0053-66		
47. -Brampton/Chinguacousy		5.0	Etobicoke Creek
48. -Brampton		1.0	
49. -Clarkson		2.25	Lake Ontario
50. -Dixie		0.4	
51. -Erindale		0.4	
52. -Lakeview		10.0	Lake Ontario
53. -Malton		0.75	
54. -Streetsville		0.8	Credit River
55. Stratford	2-0002-57	6.0	Avon River
56. Tillsonburg	2-0012-58	0.67	Otter Creek
57. Waterdown	2-0163-63	0.3	Grindstone Creek
58. Waterloo	2-0022-58	6.0 (prim) 4.0 (sec)	Grand River

TRICKLING FILTER

59. Frankford	2-0009-58	0.54 (prim) 0.12 (sec)	Trent River

* Plant extension from 3 mgd to 6 mgd completed late 1969

** Operating agreement only

INTRODUCTION

The Division of Plant Operations prepares operating summaries on all staffed OWRC projects which have been in operation for at least a year. The first summary report, prepared in 1963, compared treatment results of six primary treatment plants and 21 secondary treatment plants. The 1969 report summarizes operating data from 15 primary treatment plants and 44 secondary treatment plants. In 1969, these plants treated a total of 48 billion gallons of sewage at a total operating cost of 3.36 million dollars.

This report contains summaries of operating costs and treatment results and, hopefully, some reasons for the results obtained. While design parameters are listed along with operating results, there is no attempt made here to relate the two. More detailed information than is contained in this report can be obtained from the operating summaries for the individual plants.

LOADING AND EFFLUENT QUALITY

HYDRAULIC LOADING

Graph No. 1 displays mean hydraulic loadings as percentages of nominal capacity, in order of decreasing loading. The graph also shows the percentage of the year that daily flows exceeded design capacity. Table I summarizes hydraulic loading data for primary treatment plants, modified activated sludge plants (extended aeration and contact stabilization) and conventional activated sludge plants.

ORGANIC LOADING AND EFFLUENT QUALITY

Suspended solids and biochemical oxygen demand loadings for primary treatment and modified activated sludge plants are displayed in Graphs 2 and 3. The loadings for conventional activated sludge plants are shown in order of decreasing loading in Graphs 4 and 5, which also show the corresponding mean effluent concentrations.

Table II is a summary of mean organic loadings and reduction in concentrations. BODs and suspended solids concentrations, along with the number of samples taken and the sample standard deviations, are contained in Table III.

Mean values of primary effluent BODs and suspended solids concentrations for conventional activated sludge plants are listed in Table VII, under aeration tank influent.

NUTRIENT CONCENTRATIONS

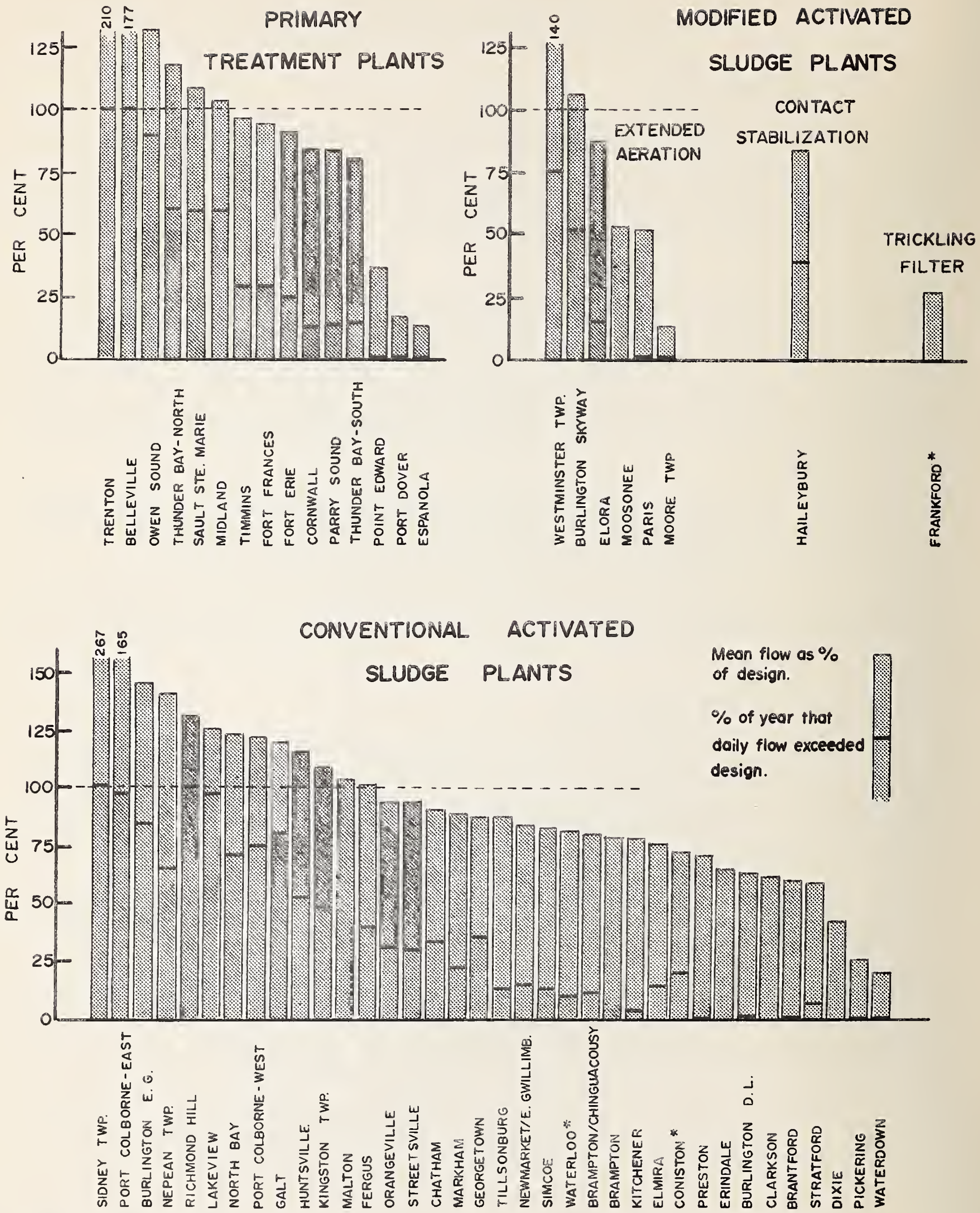
Average nutrient concentrations are listed in Table IV for primary treatment plants and modified activated sludge plants, and in Table V for conventional activated sludge plants. The nitrogen concentrations are given as milligrams per litre of nitrogen rather than in terms of the ion described. Similarly, the phosphate concentrations are given as mg/l of phosphorous.

The average influent concentrations for all plants are 20.5 mg/l N as free ammonia, 40 mg/l Kjeldahl nitrogen, 0.20 mg/l N as nitrite, 0.37 mg/l N as nitrate, 17 mg/l P as total phosphate and 8 mg/l P as dissolved phosphate.

The nitrogen concentrations in effluents from primary treatment plants averaged 13.6 mg/l free ammonia, 22 mg/l Kjeldahl nitrogen, 0.13 mg/l nitrite and 0.38 mg/l nitrate. The effluents from secondary treatment plants average 9.5 mg/l ammonia, 13 mg/l Kjeldahl nitrogen, 0.60 mg/l nitrite and 4.1 mg/l nitrate.

The effluent phosphate concentrations for both primary and secondary treatment plants averaged 8 mg/l total phosphate and 6 mg/l dissolved phosphate as P.

GRAPH No. I HYDRAULIC LOADING



* Primary treatment capacity

TABLE I HYDRAULIC LOADING

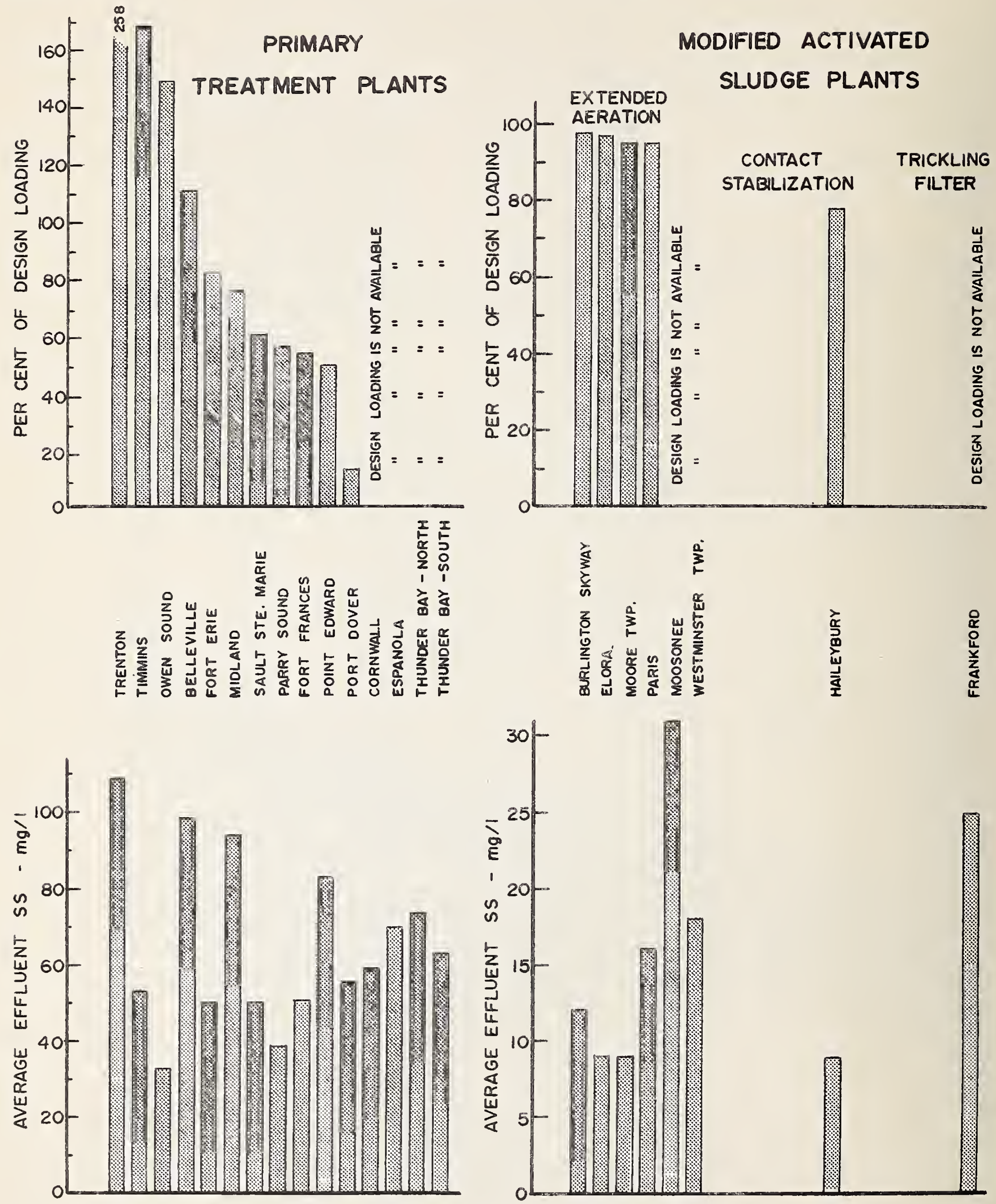
PROJECT	DESIGN CAPACITY mgd	MAXIMUM DAILY FLOW million gallons	MAXIMUM MONTH'S FLOW mgd	AVERAGE FLOW mgd	AVERAGE FLOW as % of DESIGN CAPACITY	% of YEAR DAILY FLOW EXCEEDED DESIGN CAPACITY
PRIMARY TREATMENT PLANTS						
Belleville	3.0	10.0	6.60	5.30	177	100
Cornwall	8.25	17.6	10.50	6.90	83	13
Espanola	0.66	0.28	0.12	0.09	14	0
Fort Erie	1.8	4.94	1.96	1.63	91	25
Fort Frances	2.0	3.13	2.47	1.90	95	30
Midland	1.25	3.00	1.70	1.30	104	60
Owen Sound	3.0	8.80	5.10	4.00	133	90
Parry Sound	0.83	2.16	1.10	0.70	84	14
Point Edward	0.57	0.40	0.24	0.21	37	0
Port Dover	2.1	1.45	0.42	0.36	17	0
Sault Ste. Marie	8.0	16.00	10.300	8.70	109	60
Thunder Bay North	4.0	8.00	7.10	4.70	118	61
Thunder Bay South	6.0	11.9	8.40	4.90	82	15
Timmins	3.0	5.20	3.70	2.90	97	30
Trenton	1.0	4.10	2.90	2.10	210	100
EXTENDED AERATION PLANTS						
Burlington Skyway	3.0	6.30	4.20	3.30	106	51
Elora	0.083	0.17	0.10	0.07	88	17
Moore Twp.	0.32	0.22	0.14	0.12	38	0
Moosonee	0.075	-	0.58	0.04	53	-
Paris	0.50	0.63	0.37	0.26	52	0
Westminster Twp.	0.25	0.58	0.41	0.35	140	78
CONTACT STABILIZATION PLANTS						
Haileybury	0.35	0.90	0.50	0.30	86	40
CONVENTIONAL ACTIVATED SLUDGE PLANTS						
Brantford	12.5	12.60	9.00	7.60	61	0
Burlington D. L.	2.5	3.40	1.90	1.60	64	-
Burlington E. G.	0.75	2.50	1.53	1.10	147	85
Chatham	4.5	9.70	4.90	4.10	91	35
Coniston	0.26*	0.50	0.32	0.19	73	22
Elmira	0.68	2.87	0.88	0.53	78	15
Fergus	0.6	1.72	1.07	0.60	100	40
Galt	5.0	8.50	7.10	6.00	120	82
Georgetown	1.5	2.38	1.69	1.32	88	36
Huntsville	0.25	0.55	0.39	0.29	116	52
Kingston Twp.	0.83	2.40	1.20	0.90	108	48
Kitchener	13.5	20.40	12.10	10.70	79	4
Markham	0.66	0.86	0.65	0.59	89	22
Nepean Twp.	1.5	4.90	4.30	2.10	140	66
Newmarket/E. G.	2.0	8.80	2.70	1.70	85	16
North Bay	4.0	11.10	6.50	4.90	123	72
Orangeville	0.75	1.35	0.98	0.70	93	31
Pickering	0.4	0.45	0.15	0.10	25	0
Port Colborne E.	0.85	2.20	1.70	1.50	165	97
Port Colborne W.	0.9	2.50	1.50	1.10	122	75
Preston	1.8	2.63	1.46	1.30	72	0
Richmond Hill	1.6	3.00	2.70	2.10	131	100
Sidney Twp.	0.12	0.48	0.41	0.32	267	100
Simcoe	2.0	3.51	2.12	1.70	85	13
South Peel:						
- Brampton/Ching	5.0	9.40	9.33	4.12	82	12
- Brampton	1.0	1.43	1.20	0.81	81	0
- Clarkson	2.25	-	1.65	1.43	64	0
- Dixie	0.4	-	-	0.17	42	0
- Erindale	0.4	-	-	0.26	65	0
- Lakeview	10.0	22.68	14.41	12.53	125	97
- Malton	0.75	-	-	0.77	103	0
- Streetsville	0.8	1.94	1.02	0.74	93	30
Stratford	6.0	11.20	5.37	3.60	60	9
Tillsonbrug	0.67	1.31	0.72	0.59	88	13
Waterdown	0.3	0.50	0.09	0.06	20	0
Waterloo	6.0	9.20	6.30	5.00	83	10
TRICKLING FILTER						
Frankford	0.54*	-	-	0.14	26	0

* Denotes primary treatment capacity

LOADING AND EFFLUENT QUALITY

GRAPH No. 2

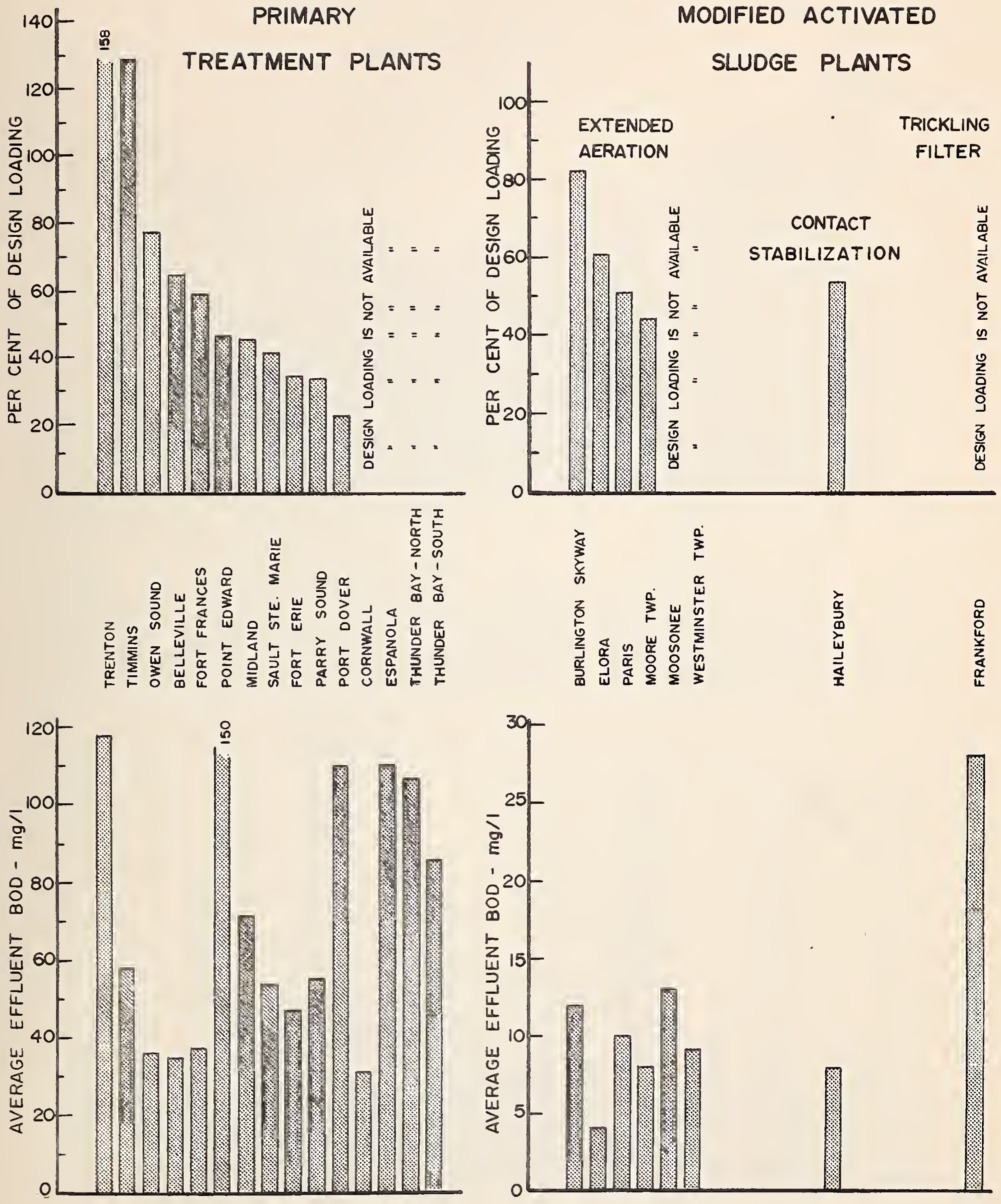
SUSPENDED SOLIDS



LOADING AND EFFLUENT QUALITY

GRAPH No. 3

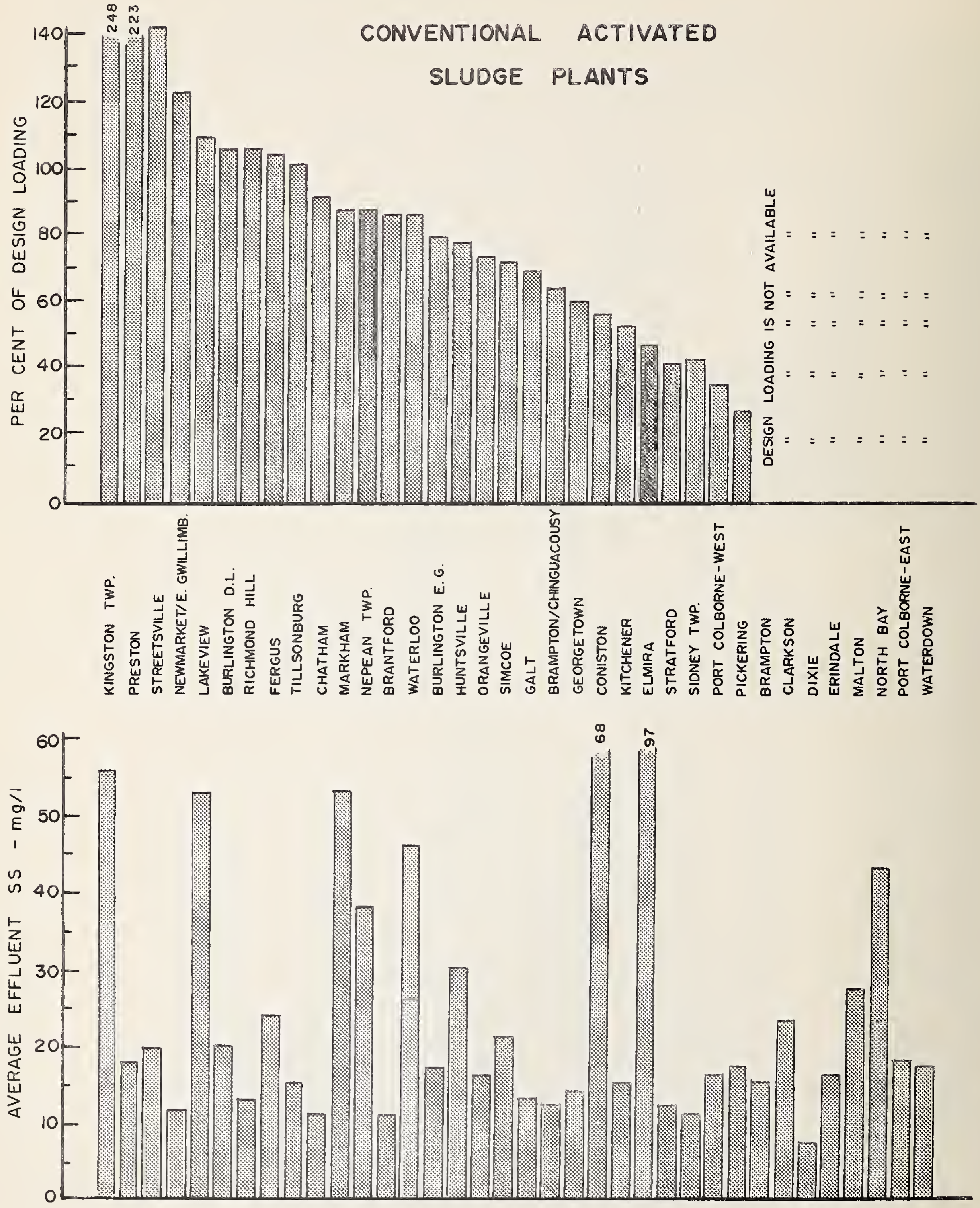
BIOCHEMICAL OXYGEN DEMAND



LOADING AND EFFLUENT QUALITY

GRAPH No. 4

SUSPENDED SOLIDS



LOADING AND EFFLUENT QUALITY

GRAPH No. 5

BIOCHEMICAL OXYGEN DEMAND

CONVENTIONAL ACTIVATED SLUDGE PLANTS

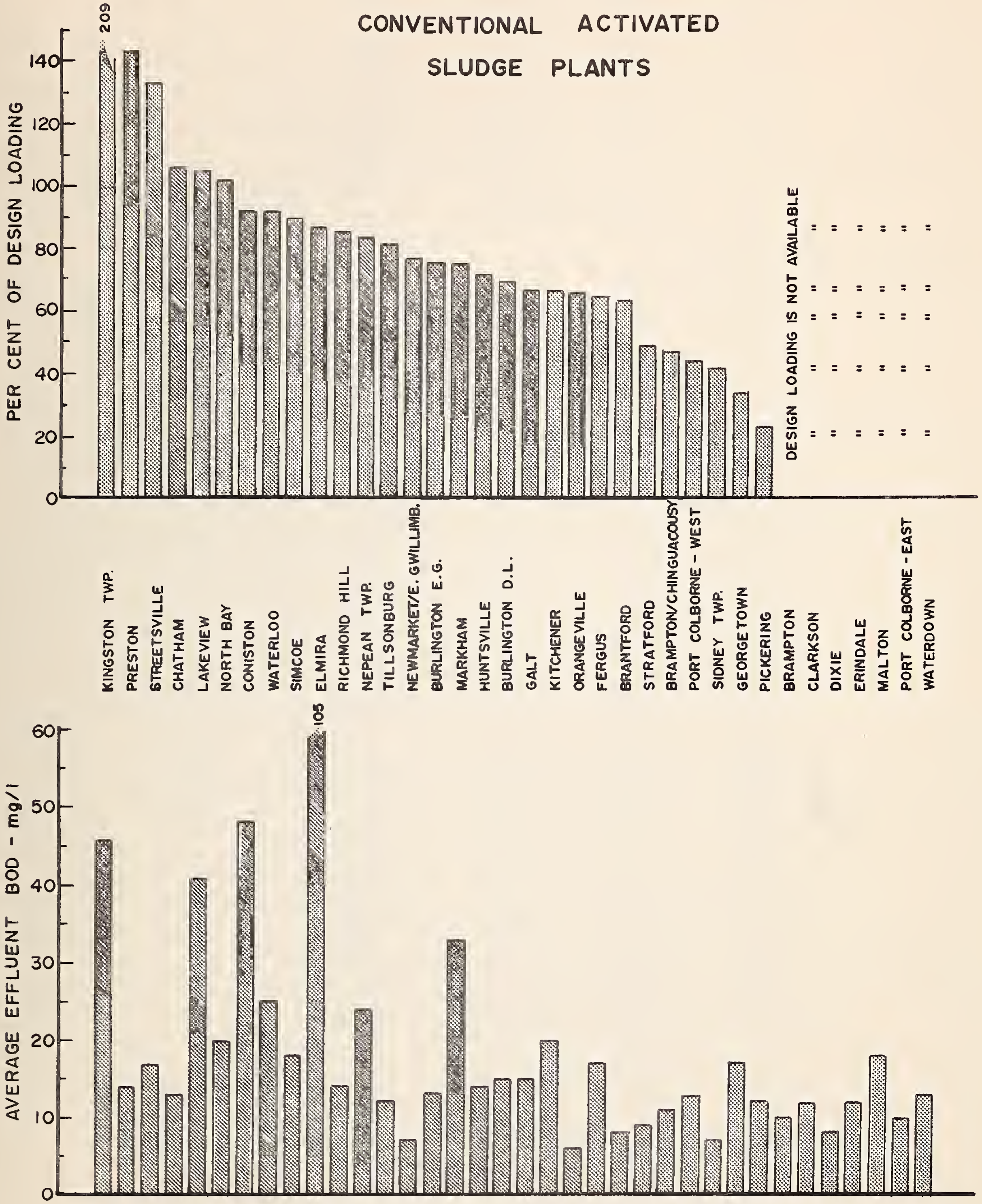


TABLE II

ORGANIC LOADING

PROJECT	DESIGN LOADING pounds per day		ACTUAL LOADING (AVERAGE)				% REDUCTION IN CONCENTRATION	
			pounds per day		% of design			
	BOD	SS	BOD	SS	BOD	SS	BOD	SS
PRIMARY TREATMENT PLANTS								
Belleville	6750	7790	4350	8740	64	112	57	42
Cornwall	-	-	3590	9660	-	-	38	58
Fort Erie	3420	2340	1160	1940	34	83	35	56
Fort Frances	2600	3600	1500	2000	58	55	53	52
Midland	2810	3750	1260	2870	45	77	29	57
Owen Sound	5400	6000	4160	8960	77	149	64	84
Parry Sound	2080	1660	680	950	33	57	44	73
Point Edward	970	1140	450	580	46	51	30	66
Port Dover	4410	6200	1000	930	12	15	60	79
Sault Ste. Marie	20000	16000	8180	9740	41	61	44	54
Thunder Bay North	-	-	8600	7660	-	-	43	55
Thunder Bay South	-	-	7200	6220	-	-	41	51
Timmins	5400	6000	6990	10100	129	169	76	85
Trenton	2500	2000	3950	5170	158	258	37	56
EXTENDED AERATION PLANTS								
Burlington Sky.	6260	6260	5110	6100	82	98	92	94
Elora	175	208	110	200	61	97	97	97
Moore Twp.	480	480	210	190	44	39	95	93
Moosonee	-	-	-	-	-	-	-	-
Paris	1000	850	510	310	51	37	95	86
Westminster	-	-	330	610	-	-	89	89
CONTACT STABILIZATION PLANTS								
Haileybury	595	700	320	550	54	78	91	94
CONVENTIONAL ACTIVATED SLUDGE PLANTS								
Brantford	21300	21900	13400	18900	63	86	94	96
Burlington D. L.	5000	4500	3440	4780	69	106	93	93
Burlington E. G.	1900	2100	1430	1650	75	79	92	91
Chatham	11300	11300	11900	10200	106	91	95	95
Coniston	520	650	480	360	92	56	80	61
Elmira	2850	2080	2440	950	86	46	77	47
Fergus	1200	1200	760	1250	64	104	87	89
Galt	12500	12500	8400	8640	67	69	89	88
Georgetown	3000	3000	1000	1810	34	60	81	91
Huntsville	625	625	440	480	71	77	91	83
Kingston Twp.	1740	2080	3640	5170	209	248	90	87
Kitchener	40500	60800	27200	31400	67	52	92	94
Markham	1440	1670	1080	1450	75	87	81	78
Nepean Twp.	2100	4430	1740	3860	83	87	72	77
Newmarket/E. G.	4400	4240	3370	5170	77	122	96	96
North Bay	6000	-	6120	9460	102	-	84	77
Orangeville	1500	1880	980	1360	66	72	95	80
Pickering	880	1000	210	320	24	33	94	94
Port Colborne E.	-	-	1600	2760	-	-	90	90
Port Colborne W.	2020	2700	890	950	44	35	85	81
Preston	5400	6300	7770	14100	144	223	98	98
Richmond Hill	3200	3520	2730	3720	85	106	89	92
Sidney Twp.	264	300	110	125	42	42	71	72
Simcoe	4400	4600	3900	3300	89	72	93	92
South Peel								
- Brampton/Ching	16000	16000	7380	10200	46	64	94	93
- Brampton	-	-	-	-	-	-	-	-
- Clarkson	-	-	-	-	-	-	-	-
- Dixie	-	-	-	-	-	-	-	-
- Erindale	-	-	-	-	-	-	-	-
- Lakeview	28200	31300	29600	33700	105	108	84	82
- Malton	-	-	-	-	-	-	-	-
- Streetsville	1920	2080	1550	2960	133	142	95	96
Stratford	8400	15000	4070	6190	48	41	92	93
Tillsonburg	1560	1660	1270	1680	82	101	94	94
Waterdown	-	-	210	220	-	-	96	96
Waterloo	18000	16200	16500	14000	92	86	94	83
Frankford	-	-	150	170	-	-	74	79

TABLE III BOD AND SUSPENDED SOLIDS CONCENTRATIONS

PROJECT	PLANT INFLUENT						PLANT EFFLUENT					
	BIOCHEMICAL OXYGEN DEMAND			SUSPENDED SOLIDS			BIOCHEMICAL OXYGEN DEMAND			SUSPENDED SOLIDS		
	NUMBER OF SAMPLES	AVERAGE mg/l	S* mg/l	NUMBER OF SAMPLES	AVERAGE mg/l	S* mg/l	NUMBER OF SAMPLES	AVERAGE mg/l	S* mg/l	NUMBER OF SAMPLES	AVERAGE mg/l	S* mg/l
PRIMARY TREATMENT PLANTS												
Belleville	11	82	69	50	171	59	11	35	22	51	98	68
Cornwall	17	45	21	16	148	120	17	31	28	16	59	65
Espanola	1	260	-	1	190	-	-	110	-	1	70	-
Fort Erie	23	73	26	28	128	56	23	47	17	29	50	17
Fort Frances	53	80	14	55	105	72	53	37	12	55	51	44
Midland	18	97	30	18	218	64	18	71	25	18	94	25
Owen Sound	23	98	66	52	233	169	23	36	13	51	33	19
Parry Sound	23	99	27	23	139	42	23	55	26	23	39	28
Point Edward	26	214	53	26	265	128	25	150	32	25	83	26
Port Dover	24	278	268	70	262	221	24	110	92	70	55	37
Sault Ste. Marie	61	92	44	82	110	46	61	54	21	76	50	19
Thunder Bay North	67	164	56	67	168	64	67	106	49	67	73	23
Thunder Bay South	58	143	72	58	126	49	58	85	43	58	63	20
Timmins	19	242	191	19	346	285	19	58	28	19	53	27
Trenton	12	189	63	12	247	148	12	118	42	12	109	29
EXTENDED AERATION PLANTS												
Burlington Sky.	24	154	109	31	214	184	24	12	9	28	12	9
Elora	27	163	137	27	284	237	27	4	2	27	9	6
Moore Twp.	73	176	57	71	155	52	74	8	4	72	9	5
Moosonee	22	105	57	22	170	128	22	13	8	22	31	18
Paris	25	210	74	33	117	79	24	10	5	32	16	13
Westminster Twp.	36	103	81	37	213	199	25	9	9	25	18	20
CONTACT STABILIZATION PLANTS												
Haileybury	12	108	29	12	180	107	21	14	13	21	30	25
CONVENTIONAL ACTIVATED SLUDGE PLANTS												
Brantford	43	180	36	226	247	86	43	8	5	217	11	4
Burlington D. L.	22	213	75	26	290	153	23	15	22	24	20	29
Burlington E. G.	26	131	46	33	169	113	25	13	18	28	17	31
Chatham	70	312	160	236	256	191	66	13	6	232	11	6
Coniston	5	246	208	5	188	63	5	48	16	5	68	22
Elmira	48	453	141	48	184	121	47	105	59	47	97	45
Fergus	29	126	67	29	218	145	30	17	16	30	24	22
Galt	66	155	50	260	139	80	22	15	7	42	13	8
Georgetown	26	80	21	26	148	48	25	17	12	24	14	15
Huntsville	21	153	40	21	153	108	21	14	13	21	30	25
Kingston Twp.	33	344	464	42	511	415	25	46	72	27	56	89
Kitchener	109	252	72	263	307	200	108	20	12	258	15	14
Markham	23	156	56	23	242	72	23	33	19	23	53	25
Nepean	32	90	53	32	186	180	22	24	15	22	38	39
Newmarket	13	204	62	13	328	202	13	7	3	13	12	8
North Bay	13	117	55	13	184	81	13	20	19	12	43	47
Orangeville	13	131	55	13	188	76	13	6	2	13	16	14
Pickering	8	173	91	8	308	316	8	12	8	8	17	21
Port Colborne E.	25	114	70	27	191	167	26	10	9	28	18	12
Port Colborne W.	22	81	28	25	88	31	22	13	13	22	16	15
Preston	24	615	257	24	1128	504	24	14	9	24	18	10
Richmond Hill	12	129	40	12	180	55	12	14	10	12	13	7
Sidney Twp.	11	35	19	11	40	17	11	7	5	11	11	8
Simcoe	28	250	97	28	189	64	34	18	16	34	12	9
South Peel:												
- Brampton/C.	28	171	60	33	239	144	17	11	10	17	12	11
- Brampton	2	195	-	2	205	-	2	10	-	2	15	-
- Clarkson	9	193	-	9	327	-	16	12	-	16	23	-
- Dixie	6	106	-	6	119	-	5	8	-	5	7	-
- Erindale	8	187	-	8	206	-	8	12	-	8	16	-
- Lakeview	287	247	87	335	269	72	278	41	24	328	53	28
- Malton	11	101	-	11	247	-	6	18	-	6	27	-
- Streetsville	13	360	197	13	430	258	13	17	13	13	20	11
Stratford	22	114	47	22	178	98	22	9	9	22	12	10
Tillsonburg	46	220	87	46	273	94	47	12	18	47	15	22
Waterdown	22	378	296	25	402	360	22	13	7	22	17	12
Waterloo	89	312	157	201	273	135	86	25	49	199	46	86
Frankford	6	105	50	6	118	60	6	28	9	6	25	8

Note: * Sample standard deviation

TABLE IV NUTRIENT CONCENTRATIONS

PROJECT	NITROGEN - as mg/l N																PHOSPHATES - as mg/l P							
	FREE AMMONIA				KJELDAHL				NITRITE				NITRATE				TOTAL PHOSPHATES				SOLUBLE PHOSPHATES			
	PLT. INF.		PLT. EFF.		PLT. INF.		PLT. EFF.		PLT. INF.		PLT. EFF.		PLT. INF.		PLT. EFF.		PLT. INF.		PLT. EFF.		PLT. INF.		PLT. EFF.	
	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.
PRIMARY TREATMENT PLANTS																								
Belleville	11	14	11	10	11	21	11	14	11	.12	11	.19	11	2.3	11	1.9	11	6	11	4	10	3	10	3
Cornwall	1	8	1	8	1	14	1	13	1	.02	1	.03	1	.01	1	.02	1	6	1	4	1	4	1	3
Espanola	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Fort Erie	20	11	22	10	21	20	22	16	21	.14	22	.09	21	.09	22	.14	22	12	22	8	21	6	21	4
Fort Frances	0	-	0	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Midland	0	-	0	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Owen Sound	0	-	0	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Parry Sound	0	-	0	0	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Point Edward	8	38	8	33	8	67	8	52	8	.34	8	.30	8	.29	8	.03	8	18	8	15	8	14	8	11
Port Dover	8	16	8	10	8	35	8	26	8	.13	8	.20	8	.10	8	.16	8	10	8	6	8	5	8	3
Sault Ste. Marie	8	16	8	19	8	28	8	26	8	.05	8	.05	8	.04	7	.04	8	13	8	12	8	6	8	6
Timmins	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Thunder Bay North	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Thunder Bay South	1	8	1	5	1	17	1	12	1	.08	1	.06	1	.12	1	.24	1	23	1	20	1	.1	1	.6
Trenton	10	10	10	10	10	30	10	22	10	.10	10	.05	10	.03	10	.03	10	12	10	8	10	5	10	5
EXTENDED AERATION PLANTS																								
Burlington Sky.	20	16	20	5	20	32	20	7	20	.09	20	.82	20	.35	19	2.7	20	16	20	8	20	8	20	6
Elora	13	45	13	2	13	81	13	4	13	.12	13	.12	13	.10	13	12.	13	16	13	9	12	8	11	8
Moore Twp.	7	44	7	.6	7	62	7	3	7	.05	7	.08	7	.05	7	18.	7	20	7	14	7	11	5	13
Moosonee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paris	3	12	3	1	3	37	3	6	3	.11	3	.04	3	1.4	3	8.7	3	9	3	4	3	5	3	3
Westminster Twp.	5	5	5	.2	5	16	5	1	5	.05	5	.58	5	.11	5	4.3	5	4	5	.6	5	.5	5	.5
CONTACT STABILIZATION PLANTS																								
Haileybury	12	22	11	3	12	38	11	4	12	.07	11	.18	12	.11	11	2.7	1	8	1	3	1	4	1	3

NOTE : * n = number of samples

TABLE V

NUTRIENT CONCENTRATIONS

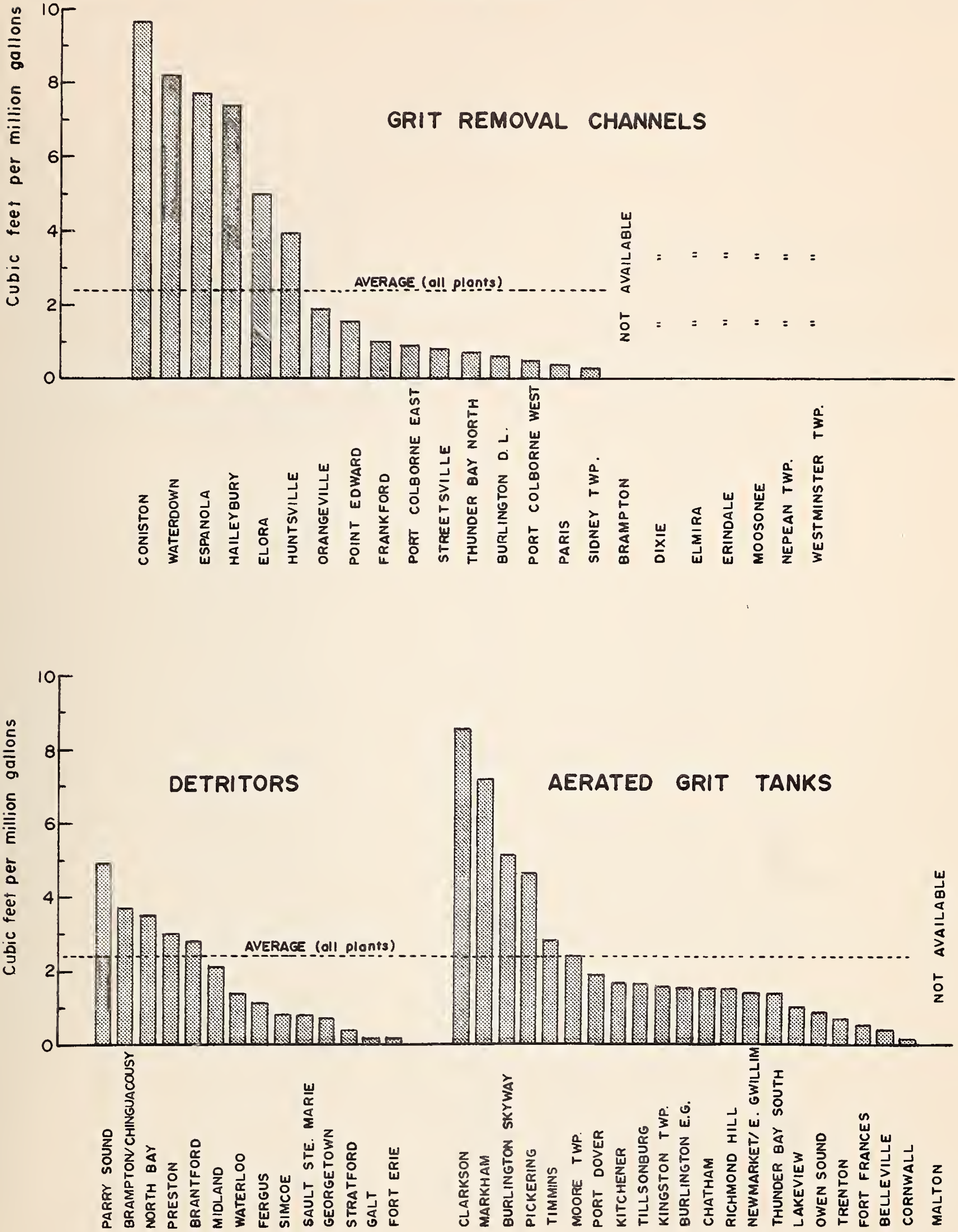
PROJECT	NITROGEN - as mg/l N																								PHOSPHATES - as mg/l P											
	FREE AMMONIA						KJELDAHL						NITRITE						NITRATE						TOTAL PHOSPHATES						SOLUBLE PHOSPHATES					
	PLT. INF.		PR. EFF.		PLT. EFF.		PLT. INF.		PR. EFF.		PLT. EFF.		PLT. INF.		PR. EFF.		PLT. EFF.		PLT. INF.		PR. EFF.		PLT. EFF.		PLT. INF.		PR. EFF.		PLT. EFF.		PLT. INF.		PR. EFF.		PLT. EFF.	
	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.	n*	AVG.
Brantford	8	15	8	15	8	9	8	66	8	71	8	17	8	.06	8	.04	8	1.2	8	.08	8	.11	8	1.2	14	23	8	24	14	8	14	8	8	8	14	5
Burlington D.L.	18	23	1	26	18	9	18	44	1	43	18	14	18	.06	1	.09	18	.1	18	.10	1	1.0	17	6.7	18	19	1	13	18	8	18	7	1	5	18	5
Burlington E.G.	21	27	1	26	20	7	21	42	2	75	20	17	21	.09	1	.14	20	1.3	21	.10	1	.01	20	4.8	21	18	22	11	20	10	21	12	1	9	20	8
Chatham	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	7	26	6	22	7	18	7	15	6	11	7	12
Coniston	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Elmira	3	26	0	-	2	39	3	62	0	-	2	64	3	11.	0	-	2	1.3	3	6.4	0	-	2	1.5	3	11	0	-	2	6	3	3	0	-	2	3
Fergus	9	23	9	21	9	6	9	48	9	30	9	7	9	.19	9	.14	9	.9	9	.56	9	.78	9	9.3	9	11	9	8	9	6	9	5	9	5	9	4
Galt	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Georgetown	4	20	4	18	4	1	23	31	22	27	21	11	23	.08	22	.12	20	.6	23	1.0	22	.38	20	.4	23	16	2	15	21	9	11	6	10	6	11	4
Huntsville	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kingston Twp.	18	20	2	21	16	16	18	52	2	37	17	19	18	.11	2	.05	17	.5	18	.12	2	.14	17	1.5	18	33	2	10	17	12	17	18	2	7	16	8
Kitchener	6	22	6	23	6	14	6	40	6	38	6	19	6	.12	6	.14	6	6.5	7	.02	7	.03	7	1.4	7	11	7	10	7	9	6	6	6	6	6	7
Markham	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Nepean Twp.	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Newmarket	8	32	8	33	8	3	8	68	8	53	8	4	8	.12	9	.09	8	.24	8	.04	8	.03	8	29.	8	23	8	15	8	11	8	9	8	8	8	7
North Bay	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Orangeville	7	15	0	-	5	7	7	25	0	-	7	10	7	.18	0	-	6	.24	7	.12	0	-	6	5.7	7	29	0	-	7	16	2	16	0	-	2	10
Pickering	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Port Colborne E.	21	18	0	-	21	11	22	29	0	-	21	14	20	.08	0	-	22	.14	20	.12	0	-	22	.6	22	14	0	-	22	5	20	8	0	-	21	4
Port Colborne W.	24	15	7	11	22	12	24	24	7	16	23	17	24	.19	7	.20	23	.13	24	.57	7	.60	23	.44	24	10	7	7	23	7	24	7	7	5	23	5
Preston	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	.-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Richmond Hill	12	27	12	26	11	12	12	39	12	33	12	14	12	.06	12	.06	11	.31	12	.06	12	.02	11	4.0	10	20	10	15	10	10	4	7	4	7	4	6
Sidney Twp.	1	9	0	-	1	1	1	10	0	-	1	1	1	.13	0	-	1	.66	1	.37	0	-	1	6.8	1	3	0	-	1	3	1	3	0	-	1	2
Simcoe	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	25	17	20	17	32	8	25	8	20	9	31	5
Stratford	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Tillsonburg	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
Waterdown	2	20	1	19	2	7	2	325	1	24	2	9	2	.05	1	.01	2	1.0	2	.05	1	.04	2	10	1	250	0	-	1	17	1	38	0	-	1	15
Waterloo	15	19	18	21	15	9	14	42	13	40	14	16	13	.04	12	.05	13	1.7	13	.05	12	.03	13	2.8	8	15	12	18	8	8	5	6	5	6	5	8
South Peel:																																				
- Brampton/C.	11	24	22	23	15	15	12	46	24	36	22	18	11	.10	22	.05	16	.8	11	.02	22	.05	16	3.5	11	12	22	10	20	8	10	5	20	6	16	6
- Brampton	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
- Clarkson	9	14	0	-	16	8	9	33	0	-	16	12	9	.20	0	-	16	.5	9	1.4	0	-	16	5.0	8	19	0	-	14	7	8	10	0	-	14	6
- Dixie	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
- Erindale	1	15	2	23	1	18	1	35	2	39	1	18	1	.04	2	.04	1	1.1	1	.04	2	.06	1	8.0	1	19	2	22	1	12	1	11	2	15	1	10
- Lakeview	12	16	0	-	41	14	12	30	0	-	41	20	12	.11	0	-	41	.06	12	.03	0	-	41	.05	12	19	0	-	40	8	12	6	0	-	40	5
- Malton	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
- Streetsville	2	22	1	23	2	4	3	41	2	30	3	6	3	.03	2	.06	3	.09	3	.07	2	.1	3	2.2	3	11	2	8	3	6	1	8	1	6	2	5
Frankford (Trickling filter)	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-

NOTE : * n = number of samples

GRIT REMOVAL

Graph No. 6 displays the annual average cubic feet of grit removed for every million gallons of flow, ranked in order of decreasing removal. The plants are grouped according to the type of grit removal facility -- channels, aerated tanks or detritors.

GRAPH No. 6 GRIT REMOVAL



PRIMARY SEDIMENTATION

Table VI summarizes hydraulic loading on primary sedimentation tanks and the resulting reductions in suspended solids concentrations, along with the attendant reduction in biochemical oxygen demand. The loadings listed do not include the effluents of sedimentation tank underflow (usually less than 5% of the influent flow), nor the added flow due to recycling of digester supernatant, filtrate and waste activated sludge.

TABLE VI PRIMARY SEDIMENTATION

PROJECT	TANK DIMENSIONS length x width x depth OR dia. x depth feet	OVERFLOW RATE				SS CONC^{n} REDUCTION %	BOD REDUCTION %
		SURFACE in gpd/ft^2		WEIR in gpd/ft			
		DESIGN	ACTUAL	DESIGN	ACTUAL		
PRIMARY TREATMENT PLANTS							
Belleville	70 x 18 x 12	600	1060	11000	19500	42	57
Cornwall	143 x 48 x 12	600	500	14300	12000	59	38
Espanola	36 x 12 x 10	773	110	9200	1300	63	58
Fort Erie	50 dia x 10	458	420	5720	5200	56	35
Fort Frances	40 x 40 x 10	625	590	9660	9200	51	53
Fort William	132 x 37 x 10	600	490	10000	8200	51	41
Midland	50 dia x 8	319	330	3970	4100	57	29
Owen Sound	78 x 32 x 12	600	800	8269	11000	84	64
Parry Sound	30 x 30 x 10	460	390	3700	3100	73	44
Point Edward	35 dia x 10	594	220	5190	1900	66	30
Port Arthur	100 x 18 x 8	560	660	6000	7100	55	43
Port Dover*	75 x 15 x 8	620	160	45600	11800	79	60
Sault Ste. Marie	70 dia x 8	520	570	13000	14200	54	44
Timmins	125 x 20 x 12	600	580	9900	9600	52	57
Trenton	52 x 16 x 12	600	1260	8340	17500	56	37
CONVENTIONAL ACTIVATED SLUDGE PLANTS							
Brantford	70 dia x 10	812	500	14200	8700	52	23
Burlington D. L.	50 x 18 x 12	1400	900	17100	10900	48	33
Burlington E. G.	22 dia x 9	980	1440	5430	8000	0	0
Chatham	80 x 32 x 12	878	800	9400	860	70	33
Coniston	29 x 29 x 16	332	240	1700	1200	50	21
Elmira	40 dia x 8	270	210	2700	2100	19	5
Fergus	40 x 40 x 9	267	270	2670	2700	54	33
Galt	60 dia x 9	884	1060	13250	15900	64	31
Georgetown	35 x 35 x 10	612	540	5360	4700	35	26
Huntsville	30 x 10 x 8	833	970	25000	29000	0	0
Kingston	46 x 12 x 8	750	810	8600	9300	67	66
Kitchener	60 x 60 x 12	765	600	26200	10700	45	28
Markham	42 x 12 x 8	660	590	27800	14700	36	36
Nepean Twp.	60 x 15 x 9	835	1170	9450	13200	56	51
Newmarket	30 x 30 x 12	1110	940	10800	920	59	44
North Bay	90 x 30 x 10	500	620	44000	54100	27	30
Orangeville	35 dia x 12	780	720	7350	6800	55	44
Pickering	20 x 12 x 12	795	200			78	67
Port Colborne W.	50 dia x 9	229	280	2860	3500	30	41
Preston	50 dia x 10	460	330	5730	4100	87	67
Richmond Hill	16 dia x 10 26 dia x 10	908	1190	4880	6400	58	44
Sidney Twp.	16 x 16 x 11	468	1250	3750	10000	13	20
Simcoe #1	50 x 20 x 8	600	500	30000	24900	41	21
Simcoe #2	45 dia x 10	440	410	5570	5200	28	5
Southern Peel County Area:							
- Brampton A	42 x 42 x 10	700	570	6750	5500	55	41
- Brampton B	50 dia x 11	765	690	9550	8600	62	46
- Lakeview	87 x 32 x 12 87 x 48 x 12	900	900	13000	13000	57	44
- Streetsville	35 x 35 x 10	650	600	6250	5800	43	29
Stratford	80 dia x 10	600	360	12000	7200	64	57
Tillsonburg	50 x 10 x 8	795	700	16000	14100	0	0
Waterdown	32 x 8 x 10	585	120	4690	940	47	47
Waterloo	75 dia x 13	680	560	12700	1000	37	16
Frankford	60 x 16 x 8	546	140	32700	8500	74	67

Note: * Two of three tanks used

SECONDARY TREATMENT

The parameters normally used to describe the biological process occurring within the aeration tank and the physical process of liquid-solid separation are summarized in Table VII. The two processes must be considered together, because the two are interrelated in the operation of the plant, and only the proper functioning of both processes produces an acceptable effluent.

TABLE VII SECONDARY TREATMENT

PROJECT	DIFFUSER or AERATOR TYPE	AVERAGE DETENTION hours	MLSS CONC^{n} mg/l	AERATION INF. CONC^{n} - mg/l		F/M lb BOD/day / lb MLSS	AIR SUPPLIED ft^3/lb BOD	WASTE SL. PRODUCED lb/day	FINAL CLARIFIER LOADING gpd/ft^2	SLUDGE RETURN RATE % of influent
				BOD	SS					
CONVENTIONAL ACTIVATED SLUDGE										
Brantford	Sparger	12.3	2930	136	119	0.11	1290	11900	500	30
Burlington D. L.	Schumacher tubes & Spargers	12.5	2180	145	155	0.15	1040	1100	640	45
Burlington E. G.	Coliflex	6.0	2120	130	237	0.23	1920	1300	690	60
Chatham	Schumacher tubes	8.4	1330	194	74	0.39	1230	1100	530	35
Coniston	ACM mech.	7.9	2900	194	98	0.25	-	-	640	-
Elmira	ACM mech.	13.6	2960	437	146	0.25	-	-	170	35
Fergus	ACM mech.	5.5	2870	85	96	0.12	-	230	490	35
Galt	ACM mech.	5.8	2840	97	52	0.14	-	1600	680	40
Georgetown	ACM mech.	9.0	1420	58	89	0.12	-	-	410	20
Huntsville	C.P. mech	7.2	770	185	280	0.72	-	-	740	30
Kingston Twp.	Discfuser	7.0	1980	138	192	0.27	1110	500	610	40
Kitchener	ACM mech.	9.4	2570	182	160	0.19	-	7900	530	85
Markham	Sparger	8.5	2660	118	155	0.19	3460	750	590	65
Nepean Twp.	ACM mech.	4.8	2110	41	80	0.11	-	620	1170	45
Newmarket/E. G.	Simcar mech.	9.4	1980	110	126	0.12	-	-	710	100
North Bay	Sparger	5.2	1550	88	141	0.28	2520	-	680	5
Orangeville	Inka	6.8	1640	79	87	0.09	15200	-	440	30
Pickering	Ceramic tubes	30.0	910	71	72	0.13	16900	-	160	-
Port Colborne E.	ACM mech.	3.6a	2490	114	197	0.33	-	600	990	10
Port Colborne W.	ACM mech.	2.4b	1520	48	60	0.34	-	-	340	45
Preston	ACM mech.	13.5	2080	199	144	0.19	-	1400	330	50
Richmond Hill	Carborundum tubes	5.5	1150	73	75	0.36	2530	-	870	25
Sidney Twp.	Aeramic tubes	2.8	1540	28	34	0.13	2200	-	1340	-
Simcoe #1	Sparger	11.5	2470	183	116	0.17	3220	360	300	50
Simcoe #2	Inka	7.0	2420	217	140	0.31	5400	780	410	50
South Peel										
- Brampton/C-A	Coliflex & Sparger	12.5	1000	105	112	0.32	1700	-	400	-
- Brampton/C-B	ACM mech.	8.7	1780	97	93	0.14	-	-	480	-
- Lakeview	Sparger	4.9	1350	133	115	0.38	1200	13100	740	30
- Streetsville	Flo-rite tubes	8.5	1550	244	228	0.47	1020	-	580	-
Stratford	Alundum tubes	6.5	2340	49	62	0.08	2690	1500	360	35
Tillsonburg	Sparger	11.6	1850	265	367	0.28	2250	3000	700	45
Waterdown	Discfuser	19.2c	2680	182	191	0.01	18300	-	250	-
Waterloo	Turbine	8.0	2690	276	176	0.35	580	2200	750	60
EXTENDED AERATION PLANTS										
Burlington Sky.	Saran tubes	30.1	3780	155	185	0.04	2240	550	460	200
Elora	Sparger	30.2	5940	142	270	0.02	3340	-	230	100
Moore Twp.	Sparger	32.0d	6440	176	157	0.02	7270	120	250	80
Moosonee	Shearfuser	45.1	5600	105	170	0.08	11200	-	110	-
Paris	ACM mech	34.4	-	210	117	-	-	-	200	-
Westminster Twp.	Discfuser	17.2	4790	94	175	0.03	2700	290	810	60
CONTRACT STABILIZATION PLANTS										
Haileybury	S & L Diffusers	3.1e	3980	107	183	-	3600	-	-	-

NOTE:
a Two of 4 cells used $\frac{1}{2}$ year, 4 cells used $\frac{1}{2}$ year
b Two of 6 cells used
c One of 2 tanks used
d One of 2 tanks used
e Detention time in contact tank

CHLORINATION AND DISINFECTION

Chlorination data and the results of bacteriological sampling are summarized in Table VIII. The average dosage required to maintain an 0.5 mg/l chlorine residual after 15 minutes is 5.6 mg/l for primary treatment plants and 3.9 mg/l for secondary treatment plants.

Chlorine used for other purposes, such as odour control and chlorination of bulking sludge, is not included in the amount of chlorine used.

Approximately one half of the plants submitted effluent bacteriological samples. Some plants, while not sampling plant effluent, samples the receiving stream upstream and downstream of the outfall.

TABLE VIII CHLORINATION AND DISINFECTION

PROJECT	AVERAGE CONTACT TIME minutes	% OF YEAR CHLORINE USED	CHLORINE USED pounds	AVERAGE DOSAGE mg/l	NUMBER OF EFFLUENT SAMPLES WITH TOTAL COLIFORMS OF							
					less than 4	4 to 32	32 to 320	320 to 3.2 x10	3.2×10^3 to 3.2×10^4	3.2×10^4 to 3.2×10^5	3.2×10^5 to 3.2×10^6	greater than 3.2×10^6
PRIMARY TREATMENT PLANTS												
Belleville		100	62,600	3.2	-	-	-	-	-	-	-	-
Cornwall	18	100	50,400	3.4	-	-	-	-	-	-	-	-
Espanola	-	-	-		-	-	-	-	-	-	-	-
Fort Erie	15	50 ~~100~~	18,000	3.1	-	-	-	-	-	-	-	-
Fort Frances	22	50	11,100	3.5	-	-	-	-	-	-	-	-
Midland	18	100	37,200	7.6	9	1	2	0	1	0	1	3
Owen Sound	8	100	32,400	2.2	12	3	3	1	1	0	2	1
Parry Sound	23	100	20,700	7.9	1	0	0	0	0	0	0	3
Point Edward	73	100	10,900	14.0	-	-	-	-	-	-	-	-
Port Dover	64	58	10,100	13.8	-	-	-	-	-	-	-	-
Sault Ste. Marie	15	50	75,300	4.6	-	-	-	-	-	-	-	-
Timmins	20	50	29,300	6.0	6	0	0	0	0	0	0	0
Thunder Bay - North	17	50	32,000	3.1	-	-	-	-	-	-	-	-
Thunder Bay - South	4	50	29,200	3.9	-	-	-	-	-	-	-	-
Trenton	18	100	21,400	2.1	0	1	0	1	1	0	3	10
EXTENDED AERATION PLANTS												
Burlington Skyway		50	18,100	3.4	1	2	1	0	0	0	0	0
Elora	45	92	1,000	4.2	0	0	0	0	0	1	0	0
Moore Twp.		100	2,900	6.4	0	0	0	0	0	1	0	0
Moosonee					-	-	-	-	-	-	-	-
Paris		100	2,600	2.7	-	-	-	-	-	-	-	-
Westminster Twp.	16	50	1,800	2.5	0	1	1	4	2	0	0	0
			(unchlorinated)		0	0	1	0	1	5	0	0
CONTACT STABILIZATION PLANTS												
Haileybury	41	50	1,600	2.7	-	-	-	-	-	-	-	-
CONVENTIONAL ACTIVATED SLUDGE PLANTS												
Brantford	8	100	71,700	2.5	-	-	-	-	-	-	-	-
Burlington D. L.		50	8,900	3.6	1	3	2	0	0	0	0	1
Burlington E. G.	7	50	4,500	3.4	3	3	5	0	0	0	0	0
Chatham	24	100	60,500	4.0	0	0	0	0	0	1	0	0
Coniston	9	42	2,000	2.8	-	-	-	-	-	-	-	-
Elmira	29	100	5,300	2.7	-	-	-	-	-	-	-	-
Fergus	15	100	9,200	3.9	2	1	0	0	0	1	0	0
Galt	11	100	60,800	2.8	39	9	12	6	7	2	7	2
Georgetown	30	100	12,900	2.7	7	5	6	3	1	1	0	0
Huntsville	31	100	3,600	3.4	5	2	1	0	0	0	0	3
Kingston Twp.	16	50	4,400	3.1	-	-	-	-	-	-	-	-
Kitchener	19	100	182,000	4.7	4	0	1	0	1	0	0	0
Markham	29	100	7,600	3.7	0	0	1	2	0	0	0	0
Nepean Twp.	12	75	28,900	5.1	2	0	0	0	0	0	0	0
Newmarket	30	50	15,500	5.0	0	0	0	0	1	0	0	0
			(unchlorinated)		0	0	0	0	0	0	1	0
North Bay	20				-	-	-	-	-	-	-	-
Orangeville	32	100	10,700	4.0	8	6	0	0	0	0	0	0
Pickering	260	58	1,100	5.3	-	-	-	-	-	-	-	-
Port Colborne - East	No Chlorination Facilities				-	-	-	-	-	-	-	-
Port Colborne - West	13	100	11,300	2.7	-	-	-	-	-	-	-	-
Preston	21	100	26,400	5.5	11	6	0	0	0	0	0	0
Richmond Hill	17	100	37,000	4.8	3	4	4	0	1	0	0	0
Sidney Twp.	9	100	3,000	2.6	10	2	3	1	2	0	1	1
Simcoe	19	50	9,800	3.2	-	-	-	-	-	-	-	-
			(unchlorinated)		0	0	0	0	1	1	0	0
Stratford	40	100	22,200	1.7	6	11	2	2	0	0	0	0
Tillsonburg	34	100	9,400	4.4	-	-	-	-	-	-	-	-
Waterdown	120	100	1,800	8.3	12	6	2	0	0	0	0	1
Waterloo		100	74,200	4.1	0	0	0	0	0	0	1	0
South Peel												
-Brampton/Ching.	17	100	60,600	4.1	1	0	0	0	0	0	0	0
-Brampton					-	-	-	-	-	-	-	-
-Clarkson					-	-	-	-	-	-	-	-
-Erindale					-	-	-	-	-	-	-	-
-Lakeview		100	264,700	5.8	-	-	-	-	-	-	-	-
-Malton					-	-	-	-	-	-	-	-
-Streetsville	22	100	7,900	3.0	-	-	-	-	-	-	-	-
TRICKLING FILTER PLANTS												
Frankford		100			1	2	1	0	0	0	0	0

SLUDGE DIGESTION

ANAEROBIC SLUDGE DIGESTION

Digester loading and performance are summarized in Table IX. The amount of gas produced averaged 13 cubic feet per pound of volatile solids destroyed. The figure excludes Belleville, where the amount of gas produced exceeded that which is theoretically possible using a pure carbon feed.

AEROBIC SLUDGE

Two plants included in this report, Haileybury and Moosonee, have aerobic digesters. There are few operating data available from either plant.

TABLE IX

ANAEROBIC SLUDGE DIGESTION

PROJECT	LOADING in lb/ft^3/ month				DIGESTER VOLUME million gallons		RAW SLUDGE			PRIMARY DIGESTED SLUDGE				SECONDARY DIGESTED SLUDGE			OVERALL V.S RED %	SUPER-NATANT T.S. %	GAS PRODUCED	
	DESIGN		ACTUAL		PRIMARY	SECONDARY	VOLUME TO DIGESTER mil gal.	TOTAL SOLIDS %	VOLATILE SOLIDS %	VOLUME REMOVED mil gal	TOTAL SOLIDS %	VOLATILE SOLIDS %	V.S. RED %	VOLUME REMOVED mil gal	TOTAL SOLIDS %	VOLATILE SOLIDS %			thousand ft^3 per month	ft^3 per lb V.S. destroyed
	PRIMARY	TOTAL	PRIMARY	TOTAL																
SINGLE STAGE DIGESTION																				
PRIMARY TREATMENT PLANTS																				
Espanola	-	-	-	-	.12	nil	0.43	-	-	-	-	-	-	-	-	-	-	-	-	-
Fort Frances	1.4	-	0.9	-	.20	"	0.84	4.0	65	0.18	8.0	44	58	-	-	-	58	0.2	73	8
Parry Sound	0.8	-	0.2	-	.14	"	0.17	5.2	62	0.086	10.2	38	62	-	-	-	62	0.4	80	20
Point Edward	1.1	-	0.3	-	.094	"	0.33	3.4	75	0.064	6.7	55	59	-	-	-	59	-	-	-
Thunder Bay N	2.0	-	2.3	-	.31	"	4.6	3.0	80	1.0	7.0	71	39	-	-	-	39	-	77	2
Timmins	1.4	-	3.2	-	.50	"	11.1	2.8	70	2.3	5.2	50	57	-	-	-	57	-	-	-
SECONDARY TREATMENT PLANTS																				
Burlington E.G.	1.6	-	0.8	-	.20	nil	0.78	3.9	75	1.0	2.7	66	35	-	-	-	35	0.3	-	-
Fergus (a)	1.4	-	0.4	-	.14	"	0.17	6.3	71	0.26	3.0	57	46	-	-	-	46	-	107	15
Huntsville	1.2	-	0.8	-	.094	"	0.28	5.2	51	0.32	3.7	41	33	-	-	-	33	1.2	-	-
Kingston Twp.	0.6	-	0.8	-	.34	"	1.1	5.1	71	0.36	4.4	53	54	-	-	-	54	1.0	-	-
Markham	0.7	-	1.9	-	.22	"	1.9	4.2	59	0.51	4.3	45	41	-	-	-	41	-	-	-
Nepean Twp.	2.0	-	2.0	-	.37	"	3.1	4.5	55	0.90	3.2	48	24	-	-	-	24	0.4	-	-
Orangeville	-	-	-	-	.22	"	1.2	-	-	0.25	4.8	40	-	-	-	-	-	-	233	-
Pickering (b)	-	-	-	-	.095	"	0.15	3.7	58	-	4.2	59	0	-	-	-	0	0.3	-	-
Port Colborne E.	-	-	0.4	-	.28	"	1.1	2.0	-	0.019	3.9	-	-	-	-	-	-	2.6	-	-
Sidney Twp.	1.5	-	1.0	-	.034	"	0.30	2.3	-	0.019	4.4	-	-	-	-	-	-	0.1	-	-
Streetsville	1.5	-	-	-	.22	"	0.67	-	-	0.70	-	-	-	-	-	-	-	1.5	-	-
Tillsonburg	1.3	-	2.2	-	.22	"	2.8	3.3	-	0.59	2.5	-	-	-	-	-	-	2.3	-	-
Waterdown	-	-	-	-	.094	"	0.20	3.5	74	0.13	2.5	73	5	-	-	-	5	1.9	-	-
MULTI-STAGE DIGESTION																				
PRIMARY TREATMENT PLANTS																				
Belleville	3.8	1.9	1.5	0.7	.25	.25	4.5	1.6	51	Same as Raw Sludge volume to Primary Digester.	0.9	42	30	0.50	6.4	42	30	0.1	545	-
Cornwall (c)	2.9	1.4	2.8	1.3	.48	.48	3.8	7.4	62		5.2	44	52	0.29	12.5	38	62	1.0	700	7
Fort Erie	2.7	1.4	1.9	0.9	.097	.095	0.49	7.1	69		5.0	62	27	0.12	6.8	54	47	0.3	144	15
Midland	4.3	2.2	4.7	2.4	.097	.095	1.0	8.6	47		5.1	40	25	0.49	10.4	35	39	1.2	114	9
Owen Sound	2.8	1.9	6.0	4.0	.20	.19	3.1	7.3	47		4.4	40	25	1.5	8.5	28	56	-	-	-
Thunder Bay S.	3.0	1.5	2.4	1.2	.44	.44	5.7	3.6	49		-	-	-	0.46	15.5	30	55	-	597	13
Trenton	2.6	1.3	6.6	3.3	.084	.084	1.9	5.6	51		2.9	-	-	0.28	11.3	40	36	0.6	169	10
SECONDARY TREATMENT PLANTS																				
Brampton/Ching.	3.7	1.8	7.4	3.7	.97	.93	16.	3.7	70		2.6	53	52	6.1	2.4	55	48	0.3	2940	18
Brantford	6.1	2.0	7.0	3.5	.60	1.2	16.	5.1	64		4.4	60	16	14.	4.5	56	28	0.3	2320	19
Burlington D.L.	2.7	1.9	1.8	1.3	.31	.1	1.9	5.8	63		4.4	53	34	0.83	5.7	48	46	0.8	233	9
Chatham	-	-	3.9	2.0	.53	.51	8.3	4.9	59		-	-	-	3.7	5.2	42	50	-	1230	12
Coniston	-	-	-	-	.028	0.005	0.13	2.8	-		-	-	-	0.16	8.3	-	-	-	-	-
Galt	-	-	5.8	1.6	.19	.48	3.6	5.9	76		3.7	64	44	2.2	4.2	62	48	1.4	-	-
Kitchener	1.1	0.3	3.3	1.2	.90	2.5	19.	6.0	70		4.0	59	38	17.	3.6	55	48	-	-	-
Lakeview	5.8	2.1	4.0	1.5	1.0	1.8	38.	4.2	66		2.9	55	37	19.	5.2	51	46	0.6	3520	9
Newmarket	2.9	1.4	4.7	2.3	.17	.18	3.2	4.8	57		-	-	-	1.2	5.5	44	41	-	372	13
North Bay	2.4	1.2	5.9	2.9	.44	.46	12.	4.1	62		-	-	-	4.6	6.7	54	28	-	965	13
Port Colborne W.	3.6	2.2	1.5	0.9	.13	.084	0.91	4.2	77		2.2	65	45	0.44	2.9	63	49	1.5	230	19
Richmond Hill	-	-	2.7	2.0	.25	.084	3.3	3.8	74		-	-	-	2.8	4.7	64	38	-	-	-
Simcoe	2.9	1.4	3.4	1.7	.27	.27	3.7	4.7	71		2.5	58	44	1.9	2.4	58	44	-	-	-
Stratford	1.8	1.2	2.1	1.4	.42	.20	2.4	7.0	68		4.2	62	23	2.2	6.1	60	29	-	517	19
Waterloo	3.5	1.8	2.5	1.3	.78	.73	7.2	5.2	65		3.0	60	19	6.2	3.4	57	29	-	1220	21

NOTE: a - Five months of operation. b - Six months of operation. c - Eight months of operation.

VACUUM FILTRATION

Table X summarizes vacuum filter operating data. Port Dover used ferric chloride and lime as conditioning chemicals during periods when fish-processing wastes made organic polyelectrolytes ineffective. Data for the two periods are listed separately. At Sault Ste. Marie, owing to the nature of the wastes, conditioning chemicals were required on only one of 207 days of filtering.

At the end of 1969, there were no secondary treatment plants with anaerobic digestion using vacuum filters. Operation of the two filters at Brantford was suspended on July 19. The sludge from these plants is hauled away for disposal as liquid sludge. The cost of disposal of the larger volume of liquid sludge is less than the cost of dewatering and disposal of the filter cake.

TABLE X VACUUM FILTER OPERATION

PROJECT	DESCRIPTION OF FILTER(S)			TOTAL FILTER USE		SLUDGE TO FILTER			HYDRATED LIME		FERRIC CHLORIDE		POLYMER			FILTER YIELD	FILTRATE CONCN	FILTER CAKE	AMOUNT HAULED
	NUMBER	TYPE	TOTAL AREA ft^2	DAYS	HOURS	VOLUME 10^3 gallons	CONCN % T.S.	DRY SOLIDS 10^3 pounds	100 % CaO 10^3 pounds	DOSAGE %	100% $FeCl_3$ 10^3 pounds	DOSAGE %	TYPE	WT. USED pounds	DOSAGE ppm	lb/ft^2/hr	% T.S.	% T.S.	yd^3
SLUDGE TYPE: PRIMARY RAW																			
Port Dover	1	Cloth	200	11	58	78	9.2	73	7.5	10.3	1.6	2.2	-	-	-	6.3	.8	27	181
				11	65	110	7.3	78						66	850	6.1	.5	24	198
Total				22	123	188	-	151	7.5	-	1.6	-	Reten 210	66	-	-	-	-	379
Sault Ste. Marie	2	Coil	400	206	1105	6373	5.7	3896								8.1	.6	26	7488
				1	7	19	8.0	15	-	-	-	-	Alchem	1.3	89	8.0	1.6	36	28
Total						6392		3911	0	-	0	-		1.3	-	-	-	-	7516
SLUDGE TYPE: PRIMARY plus WASTE ACTIVATED																			
Preston	1	Coil	250	217	933	2331	8.6	1876	186	10.0	53.2	2.8	-	-	-	8.1	1.1	22	5232
SLUDGE TYPE: PRIMARY plus WASTE ACTIVATED, DIGESTED																			
Brantford *	2	Coil	700	137	2177	9060	5.3	4840	625	12.9	50.3	1.0	-	-	-	3.1	1.4	19	9560
Brampton/Ching.	1	Coil	450	Not in use															
Galt	1	Cloth	350	Not in use															
Kitchener	1	Coil	500	Not in use															
Waterloo	1	Coil	300	Not in use															

* NOTE: Ceased operation on July 19, 1969

MATERIAL BALANCE

Table XI presents material balances on those plants for which sufficient information was available. It was possible to do this on only twenty-four or fifty-two plants.

SOLIDS REMOVAL

Ultimately, all solids removal in the plant is effected in the primary sedimentation tank: the total amount of solids introduced to the tank is composed of influent suspended solids, digester supernatant, filtrate, and waste activated sludge. The total weight of solids removed is therefore the sum of the above minus the solids in the primary effluent. The amount of raw sludge removed from the primary tank should equal the weight of solids removed by the tank. The largest source of error is probably the solids concentration of the raw sludge; the concentration does not remain constant from pumping to pumping or even for the duration of one pumping cycle. If there is a large difference between solids removed by the primary tank and the amount removed from the tank, samplign methods (especially for raw sludge) and metering should be chekced.

SOLIDS DISPOSAL

Since those plants hauling raw liquid sludge pump directly from the clarifier to the tank truck, the amount removed from the clarifier and the amount disposed is the same (though not necessarily in accord with the amount removed by primary sedimentation). The filtrate quantities are calculated from mass balance formulae, inferring that those plants filtering raw sludge would show no difference between the amount disposed and the amount removed for disposal.

Again, the largest contributing factor to the difference between the amount disposed and that for disposal (weight of raw sludge to digester minus the sum of weight loss due to digestion and the amount recycled as supernatnat) is probably due to raw sludge sampling. The digested sludge is reasonably homogeneous and, in the case of single stage digestion, should be completely so.

TABLE XI MATERIAL BALANCE

PROJECT	SOLIDS REMOVAL							SOLIDS DISPOSAL			
	a	b	c	d	e	f	g	h	i	j	k
	INFLUENT SUSPENDED SOLIDS	FILTRATE and/or SUPERNATANT	WASTE ACTIVATED SLUDGE	PRIMARY EFFLUENT SUSPENDED SOLIDS	TOTAL IN a + b + c − d	RAW SLUDGE PUMPED	% DIFFERENCE $\frac{f-e}{e} \times 100\%$	REDUCTION IN DIGESTION	TOTAL f − h − b	SLUDGE DISPOSAL	% DIFFERENCE $\frac{j-i}{i} \times 100\%$
PRIMARY TREATMENT PLANTS											
Belleville	8740	120	0	5190	3670	1970	− 47	300	1550	880	-43
Cornwall	9660	1440	0	4070	7030	7700	+ 10	2960	3300	800	-76
Fort Erie	1940	30	0	800	1170	950	− 19	110	810	220	-73
Fort Frances	2000	40	0	970	1070	920	− 14	350	530	390	-26
Midland	2870	170	0	1220	1820	2360	+ 30	430	1760	1390	-21
Parry Sound	950	10	0	270	690	240	− 65	90	140	240	+71
Port Dover	930	40	0	200	750	410	− 45	-	-	-	-
Sault Ste. Marie	9740	520	0	4350	5190	10700	+106	-	-	-	-
Trenton	5170	270	0	2290	3150	2920	− 7	540	2110	870	-59
CONVENTIONAL ACTIVATED SLUDGE PLANTS											
Brantford	18900	200	11900	7600	23400	16200	− 31	2900	13100	17200	+31
Burlington D. L.	4780	240	1100	2480	3640	3020	− 17	880	1900	1300	-32
Burlington E. G.	1650	0	1300	2610	340	830	+144	220	610	740	+21
Elmira	950	0	0	760	190	700	+270	-	-	-	-
Fergus	1250	0	230	580	900	700	− 22	230	470	210	-55
Galt	8640	500	1600	3120	7620	5830	− 22	2120	3210	2540	-21
Kingston Twp.	5170	200	500	1730	4140	1540	− 63	590	750	310	-59
Kitchener	31400	0	7900	17100	2200	31200	+ 40	10500	20700	16800	-19
Lakeview	33700	3100	13100	14400	25500	43600	+ 23	13200	27300	27000	- 1
Nepean Twp.	3860	250	620	2100	32630	3920	+ 49	520	3150	790	-75
Pickering	320	0	0	70	250	300	+ 20	0	300	0	-
Preston	14100	940	1400	1870	14570	7000	− 52	-	-	-	-
Stratford	6190	0	1500	2230	5460	4610	− 16	910	3700	3680	- 1
Waterdown	220	40	0	110	150	190	+ 27	10	140	90	-36
Waterloo	14000	0	2200	8800	7400	10200	+ 38	1920	8280	5760	-30

OPERATING STAFF

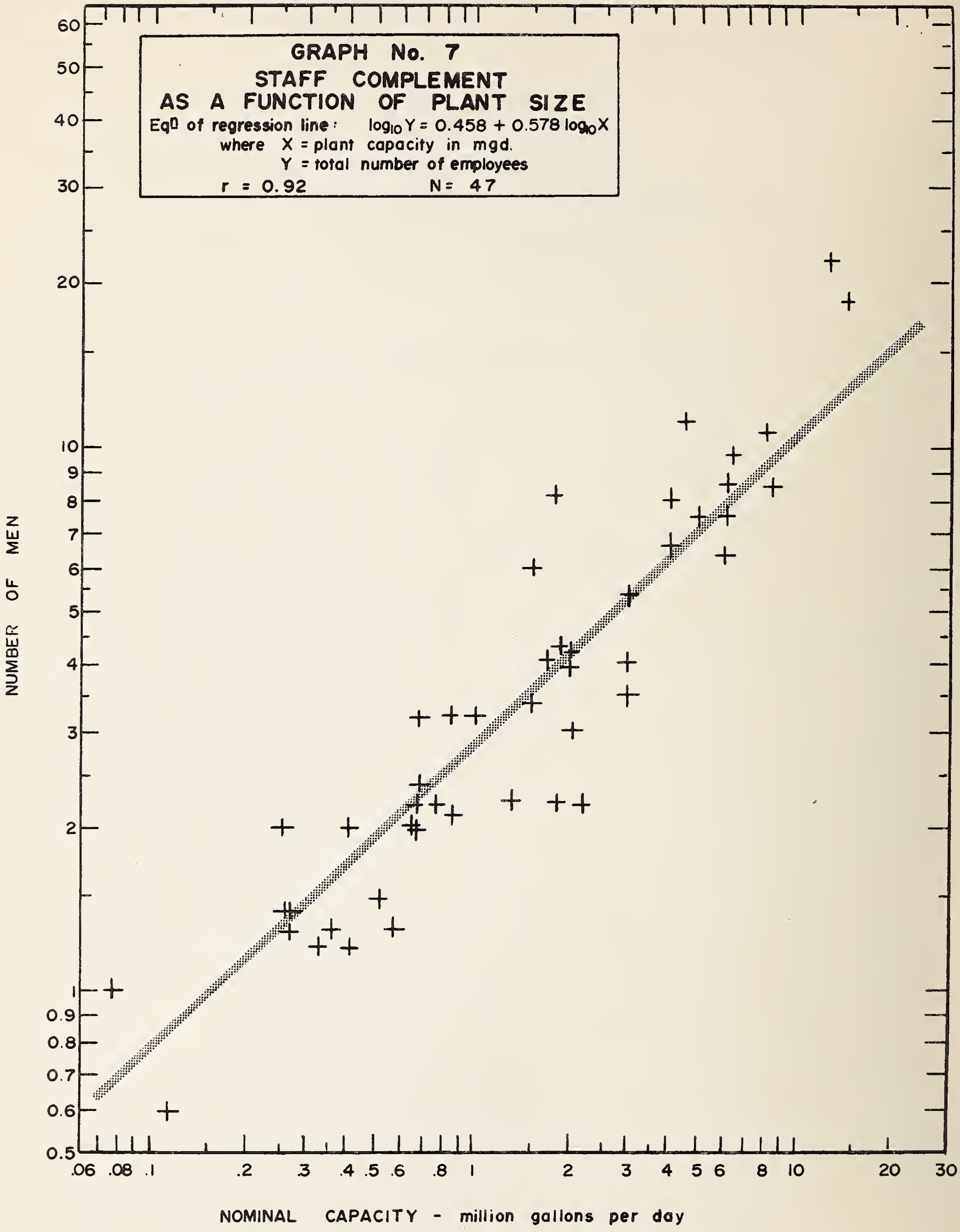
During 1969, the water pollution control plants, excluding those in the South Peel system, employed a total of 203 permanent employees and about 17 casuals. The number of men employed in the various job classifications is summarized in Table XII.

Graph No. 7 shows the variation in staff complement with nominal plant capacity. There is no significant difference in staff size between primary and secondary treatment plants.

TABLE XII OPERATING STAFF

PROJECT	SUPERINTENDENT	ASSISTANT SUPERINTENDENT	CHIEF OPERATOR	FOREMAN	MECHANIC	ELECTRICIAN	LABORATORY TECHNICIAN	FILTER OPERATOR	OPERATOR	GROUNDSKEEPER/JANITOR	CASUAL	TOTAL COMPLEMENT	SHIFTS PER DAY	MEN PER MGD DESIGN
PRIMARY TREATMENT PLANTS														
Belleville			1		1[a]				3		0.3	5.3	1	1.8
Cornwall	1	1			1				5		0.2	8.2	2	1.0
Espanola			1						1			2.0	1	3.0
Fort Erie			1						1		0.2	2.2	1	1.2
Fort Frances			1						2			3.0	1	1.5
Midland			1						1		0.2	2.2	1	1.8
Owen Sound			1						2	1		4.0	1	1.3
Parry Sound			1						1		0.1	2.1	1	2.5
Point Edward			1								0.3	1.3	1	2.3
Port Dover			1						1		0.1	2.2	1	1.0
S.S. Marie	1				2				5	1	0.6	10.6	1	1.3
Thunder Bay N.			1		1				3		1.6	6.6	2	1.6
Thunder Bay S.			1		2				4		0.4	7.4	2	1.2
Timmins			1						2		0.5	3.5	1	1.2
Trenton [b]			0.9						1.5		0.8	3.2	1	3.2
SECONDARY TREATMENT PLANTS														
Brantford	1	1		1	2		1	2	11	2	1.0	22.0	3	1.8
Burlington (3)	1		1		2				5		0.6	9.6	1	1.5
Chatham	1	1			2		1		5	1	0.2	11.2	2	2.5
Coniston			1								0.4	1.4	1	5.4
Elmira			1						2[c]		0.2	3.2	1	4.7
Elora-Fergus			1						1		0.4	2.4	1	3.5
Frankford			1								0.3	1.3	1	2.4
Galt	1				1		1		4		0.5	7.5	2	1.5
Georgetown			1						2[d]		0.4	3.4	1	2.3
Haileybury			1						0.3			1.3	1	3.7
Huntsville			1								1.0	2.0	1	8.0
Kingston			1						2		0.2	3.2	1	3.9
Kitchener	1	1		1	1	1	1		10	2	1.5	19.5	3	1.4
Markham			1						1		0.2	2.2	1	3.3
Moore Twp.			1								0.2	1.2	1	3.8
Moosonee			0.5						0.5			1.0	1	26.3
Nepean			1						4		1.0	6.0	2	4.0
Newmarket			1						2	1		4.0	1	2.0
North Bay	1				1	1[e]			4		1.0	8.0	2	2.0
Orangeville			1						1		0.2	2.2	1	2.9
Paris			1								0.5	1.5	1	3.0
Pickering			1						1			2.0	1	5.0
Port Colborne	1				1				6		0.2	8.2	3	5.0
Preston			1						3		0.3	4.3	1	2.4
Richmond Hill			1						3		0.1	4.1	1	2.6
Sidney Twp.[f]			0.1						0.5			0.6	1	5.0
Simcoe			1		1				2		0.2	4.2	1	2.1
Stratford	1	1[g]							4		0.3	6.3	2	1.0
Tillsonburg			1						1			2.0	1	3.0
Waterdown			1								0.2	1.2	1	4.0
Waterloo	1				1		1		5		0.5	8.5	2	1.4
Westminster			1								0.4	1.4	1	5.6

NOTE:
- a Operator - Mechanic
- b Jointly operated with SIDNEY TWP.
- c Senior Operator
- d One Operator is Maintenance - Operator
- e Plant Electrician is Assistant Superintendent
- f Jointly operated with TRENTON
- g Assistant Superintendent is Operator


GRAPH No. 7
STAFF COMPLEMENT
AS A FUNCTION OF PLANT SIZE
Eqn of regression line: $\log_{10} Y = 0.458 + 0.578 \log_{10} X$
where X = plant capacity in mgd.
Y = total number of employees
r = 0.92
N = 47
NUMBER OF MEN
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0.9
0.8
0.7
0.6
0.5
.06
.08
.1
.2
.3
.4
.5
.6
.8
1
2
3
4
5
6
8
10
20
30
NOMINAL CAPACITY - million gallons per day

OPERATING COSTS

The operating costs of water pollution control plants included in this report comprise staff payroll, fuel, power, chemicals, general supplies, equipment, repairs and maintenance, sundry, water and travel. The cost of head office supervision, including travel, accounting, purchasing and inspection is not charged against the project.

Items included in each category are as follows:

1. Payroll - Regular: Staff salaries including pension, medical plan and Workmen's Compensation payments.
    - Casual: Salaries of labour employed on a temporary or part-time basis during staff shortages, or for part-time work. Workmen's Compensation payments are also included.
2. Fuel - Includes fuel oil and natural or propane gas used for heating.
3. Power - Includes hydro-electric power, and natural gas, gasoline, and Diesel fuel if used for power generators.
4. Chemicals - Includes chlorine, sodium hypochlorite, ferric chloride, hydrated lime, odour control chemicals, and vacuum filter and sewer cleaning chemicals (where applicable).
5. General - Includes laboratory reagents, laboratory equipment replacement, cleaning materials, lubricants, stationery, uniforms, light bulbs, instrument charts and books.
6. Equipment - Includes equipment to be used in the treatment process, laboratory, building, grounds, maintenance and small tools.
7. Repairs & Maintenance - Includes goods and services (excluding OWRC staff) used in the repair and maintenance of process, electrical equipment and buildings, inspections, packing materials, paints, etc.

8. Sundry - Includes express charges, telephone, telemetering, sludge haulage, insurance, taxes, etc.

9. Water - Includes all charges for water.

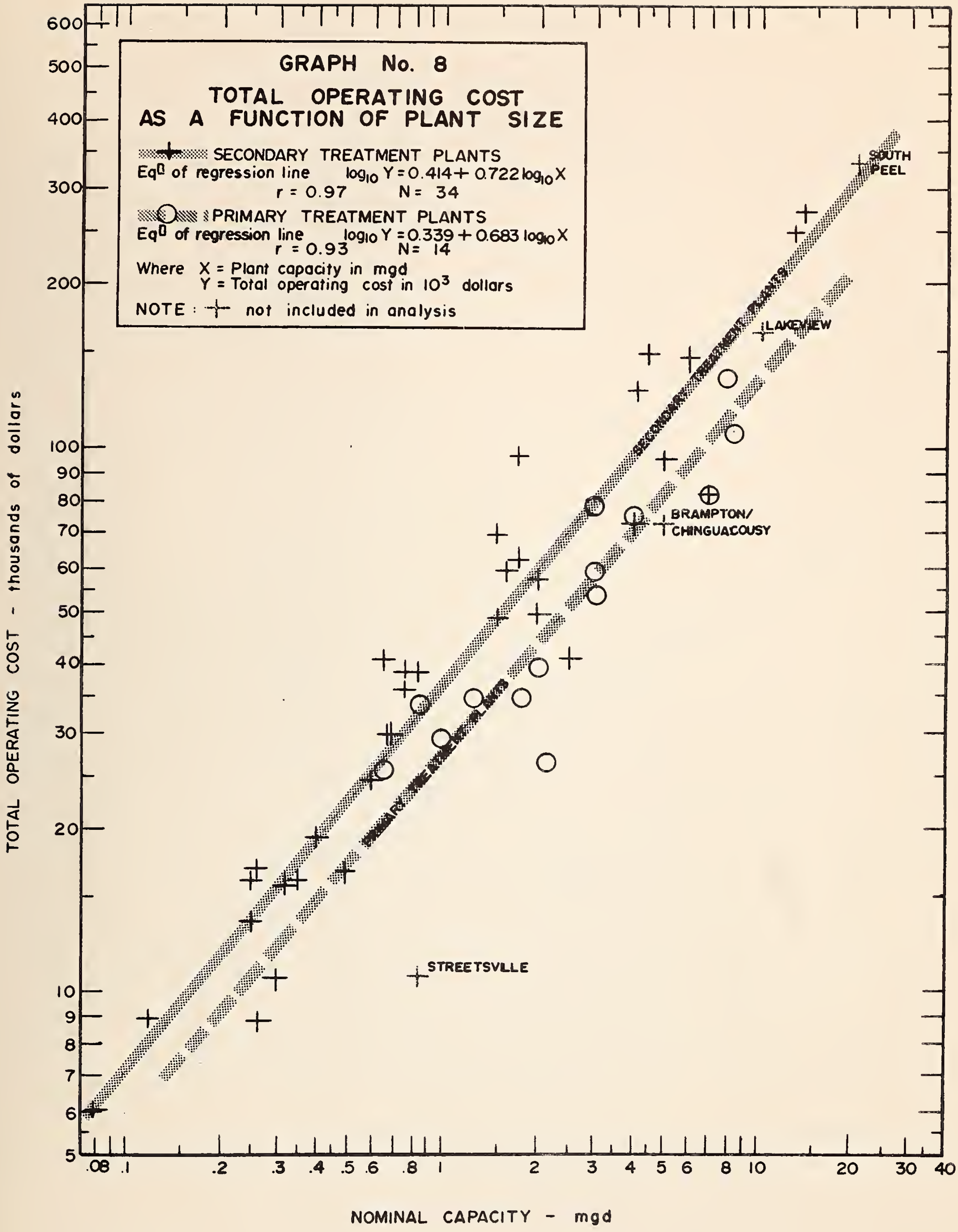
10. Travel - Includes operator's travel to local hardware stores, railroad stations, conferences, conventions, etc. The cost of accommodation and meals associated with conferences and conventions is also included.

The operating costs of the 51 OWRC-operated water pollution control plants and the South Peel system are summarized in Tables XIII and XIV. The plants are grouped according to the type of treatment -- primary, extended aeration, conventional activated sludge or trickling filter.

Graph No. 8 shows regression lines representing total operating costs for primary and conventional activated sludge plants of various design capacities. The plants in the South Peel system were not used in the analysis, since the period of operation was less than one year. The projected annual costs for the Brampton/ Chinguacousy, Lakeview and Streetsville plants and for the South Peel system are included as individual.

Table XV is a summary of unit operating costs and sludge disposal costs. The average cost of operating primary treatment plants in 1969 was $99.93 per million gallons, 15.6 cents per pound of BOD or 8.7 cents per pound of suspended solids removed. The corresponding unit costs for extended aeration plants were $235.14, 20.3 cents and 15.4 cents and for conventional activated sludge plants, $153.51 per million gallons, 10.0 cents per pound of BOD of 8.5 cents per pound of suspended solids removed.

The operating cost per capita is shown on Graph No. 9 for various populations served. The population figures were taken from the 1970 Municipal Directory.


GRAPH No. 8
TOTAL OPERATING COST AS A FUNCTION OF PLANT SIZE
SECONDARY TREATMENT PLANTS
Eqⁿ of regression line $\log_{10} Y = 0.414 + 0.722 \log_{10} X$
r = 0.97 N = 34
PRIMARY TREATMENT PLANTS
Eqⁿ of regression line $\log_{10} Y = 0.339 + 0.683 \log_{10} X$
r = 0.93 N = 14
Where X = Plant capacity in mgd
Y = Total operating cost in 10^3 dollars
NOTE : ┼ not included in analysis
SECONDARY TREATMENT PLANTS
PRIMARY TREATMENT PLANTS
SOUTH PEEL
LAKEVIEW
BRAMPTON/ CHINGUACOUSY
STREETSVILLE
TOTAL OPERATING COST - thousands of dollars
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
NOMINAL CAPACITY - mgd
.08
.1
.2
.3
.4
.5
.6
.8
1
2
3
4
5
6
8
10
20
30
40

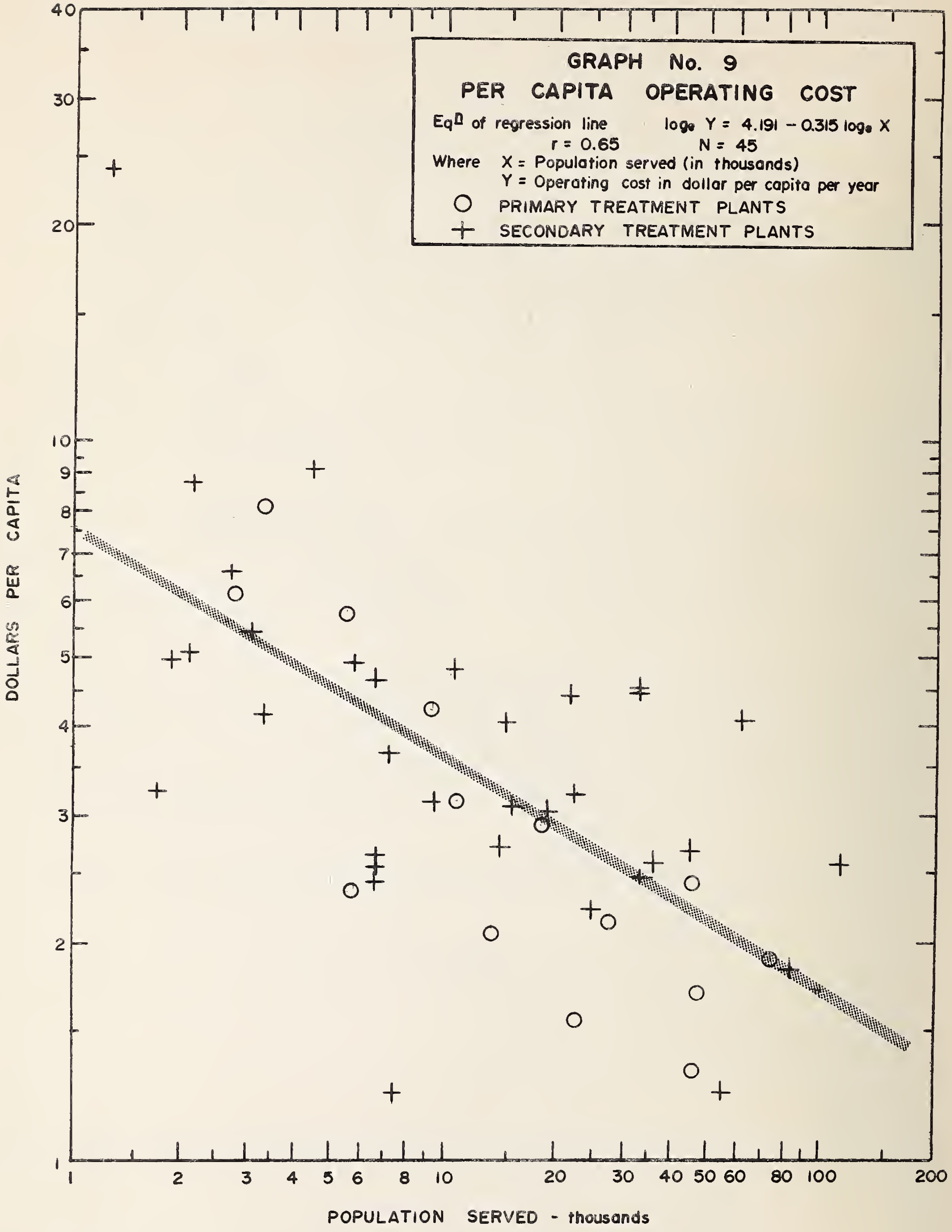

GRAPH No. 9
PER CAPITA OPERATING COST
Eqⁿ of regression line log$_e$ Y = 4.191 − 0.315 log$_e$ X
r = 0.65 N = 45
Where X = Population served (in thousands)
Y = Operating cost in dollar per capita per year
○ PRIMARY TREATMENT PLANTS
+ SECONDARY TREATMENT PLANTS
40
30
20
10
9
8
7
6
5
4
3
2
1
DOLLARS PER CAPITA
1
2
3
4
5
6
8
10
20
30
40
50
60
80
100
200
POPULATION SERVED - thousands

TABLE XIII

OPERATING COSTS

PROJECT	TOTAL	REGULAR PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICALS	GENERAL SUPPLIES	EQUIPMENT	REPAIRS and MAINTENANCE	SUNDRY (incl. sl haulage)	WATER	TRAVEL
PRIMARY TREATMENT PLANTS												
Belleville	82403.67	28001.82	1029.41	1952.16	8706.96	5549.25	3697.40	3351.94	5338.63	19737.11	3905.74	1073.29
Cornwall	111646.51	57259.89	836.69	3464.16	19353.75	3843.29	6252.95	7726.42	1924.95	10446.09	0	538.32
Espanola	13750.84	7928.65	0	0	3718.99	1030.45	63.56	0	632.50	202.14	0	174.55
Fort Erie	34664.71	15847.09	779.11	629.96	5328.48	1051.05	1755.11	277.88	2533.26	5864.29	0	598.48
Fort Frances	38741.52	22293.98	0	1190.16	4877.96	1757.57	1980.04	55.38	1736.18	3971.10	325.00	554.15
Midland	35187.35	16732.86	667.93	1622.43	3073.67	3300.15	1524.79	319.84	2565.01	4724.55	520.92	135.20
Owen Sound	53549.66	24702.64	2467.62	746.08	5938.92	2091.88	1321.50	1029.33	1693.45	11877.65	1271.43	409.16
Parry Sound	33021.33	14376.99	478.76	1272.19	6733.06	3202.79	1426.29	152.63	3825.62	987.98	1372.80	192.22
Point Edward	17289.69	8291.65	1429.65	1136.18	1444.47	1579.72	469.57	688.00	259.87	1790.02	61.56	139.00
Port Dover	27326.42	15201.48	591.22	0	4537.01	2690.84	1550.83	331.44	1166.79	1084.26	0	172.55
Sault Ste. Marie	146194.04	74859.76	2185.78	2418.23	20494.56	6423.18	4740.67	237.63	4231.38	26447.90	3549.00	605.95
Thunder Bay S.	83863.21	47171.69	2656.98	2485.15	11874.09	3259.20	2275.20	417.59	6498.06	6041.57	347.88	835.80
Thunder Bay N.	63095.36	29835.81	7272.92	1775.53	6338.55	3493.05	2377.28	382.27	3592.54	5930.46	1567.07	529.88
Timmins	59394.86	22686.41	3527.38	3538.22	4521.41	2988.42	2750.12	809.84	2129.14	16072.00	0	371.87
Trenton	28799.25	14349.41	493.50	923.39	3574.32	2682.23	1243.66	78.10	2677.24	1444.07	595.72	737.61
EXTENDED AERATION PLANTS												
Burlington Sky.	80952.25	30333.23	3061.42	0	29351.23	1667.06	2860.38	975.00	1364.95	10123.23	361.80	853.95
Elora	5743.38	2434.31	0	0	1611.00	0	275.77	0	363.60	378.30	0	680.40
Moore Twp.	16333.25	7831.23	1103.72	0	4184.30	389.83	1003.75	147.00	287.47	1273.24	119.76	(7.05)
Moosonee	30562.77	7976.69	0	732.40	17640.64	0	1250.73	1158.35	457.36	1127.82	0	218.78
Paris	16326.58	8004.03	1727.51	60.75	2149.12	606.11	446.19	130.14	1027.79	1287.41	197.57	689.96
Westminster	17264.18	7727.16	2130.65	0	2172.51	296.19	1062.25	723.18	1512.89	1214.30	0	425.05
CONTACT STABILIZATION PLANTS												
Haileybury	16738.90	7192.55	1850.18	0	3524.81	220.50	738.48	403.56	715.84	1707.36	0	385.62

TABLE XIV

OPERATING COSTS

PROJECT	TOTAL	REGULAR PAYROLL	CASUAL PAYROLL	FUEL	POWER	CHEMICALS	GENERAL SUPPLIES	EQUIPMENT	REPAIRS and MAINTENANCE	SUNDRY (incl sl. haulage)	WATER	TRAVEL
CONVENTIONAL ACTIVATED SLUDGE PLANTS												
Brantford	254678.50	137683.06	1372.01	1022.36	26176.43	17942.45	5772.58	1076.28	5268.24	56628.50	1525.63	210.96
Burlington D. L.	42152.71	22139.81	752.33	26.97	8015.65	1405.78	1127.23	65.55	1462.50	7087.59	69.30	0
Burlington E. G.	28721.33	9758.24	189.91	400.07	5430.26	1271.12	989.79	172.96	1600.39	8320.11	588.48	0
Chatham	149745.68	76118.54	595.63	1224.55	39754.98	5851.13	3614.40	424.75	3465.40	13170.71	4612.90	912.69
Coniston	18073.73	8134.43	2496.09	424.68	1438.48	269.17	985.00	97.66	1605.88	1553.78	0	1068.56
Elmira	41145.28	20694.25	2767.94	719.47	2917.70	1105.84	2302.57	1115.56	3673.74	3907.90	1437.10	503.21
Fergus	25448.57	12761.82	812.65	509.86	1395.36	1436.87	1157.88	941.22	1136.71	5113.90	32.40	149.90
Galt	94613.16	51078.42	1945.05	396.27	8666.68	4409.80	3639.27	3696.39	6734.36	12749.96	770.33	526.63
Georgetown	48582.44	22015.23	882.15	534.72	5616.24	2014.96	2006.39	353.35	1818.98	12257.97	0	1082.45
Huntsville	14072.02	6968.07	0	374.15	2056.43	545.27	1116.32	0	732.75	2120.53	158.50	0
Kingston Twp.	39254.02	22125.43	562.85	388.17	7674.15	661.50	2562.95	771.68	1677.19	2362.81	0	467.29
Kitchener	275557.76	131204.26	4389.08	0	28742.81	12189.83	12321.99	3862.25	7944.72	73926.92	301.76	674.14
Markham	29098.52	15493.23	540.53	1025.47	3925.27	1138.72	1206.44	192.26	1652.61	3545.11	150.93	227.95
Nepean	71457.17	32800.79	1692.43	474.05	10322.16	4386.89	3958.50	1616.21	6880.56	9107.42	0	218.16
Newmarket/E. G.	56884.48	27987.84	543.05	341.82	8559.72	2531.13	1243.36	618.79	2643.11	11598.51	350.00	467.15
North Bay	121522.69	54297.03	5384.02	7942.60	5772.10	3179.61	5250.32	699.45	5831.70	31390.52	1705.44	69.90
Orangeville	26579.37	13989.03	456.12	1894.77	2270.08	1654.65	1650.11	633.36	883.33	2905.97	0	241.95
Pickering	18659.85	10238.07	224.00	471.04	1702.90	644.60	1065.25	1508.72	84.29	911.24	1528.39	281.35
Port Colborne	97206.18	61655.30	1098.43	1270.07	12130.49	1751.29	4910.13	764.49	2937.25	10233.06	217.82	237.85
Preston	62603.47	29649.84	899.68	582.16	5984.88	4943.93	1911.79	426.07	2046.29	15321.17	373.32	464.34
Richmond Hill	60794.64	28738.97	469.24	728.77	7423.30	5376.79	1606.97	229.82	2935.33	12919.90	0	365.55
Sidney Twp.	9314.82	5819.89	0	699.83	816.82	454.39	265.96	0	169.30	579.51	0	509.12
Simcoe	50722.79	29851.77	60.66	336.48	11125.35	1997.04	1812.67	973.00	2149.59	1303.38	699.00	413.85
*Southern Peel County Area:												
- Brampton/Ching.	74964.81	26606.18	2065.42	5462.79	7704.76	2843.26	3021.37	458.93	2522.63	21873.33	2217.39	188.75
- Lakeview	167708.37	45500.81	4923.99	86.70	16652.99	4221.84	2629.72	725.50	6114.99	86215.96	318.68	317.19
- Streetsville	11061.75	3876.63	1267.81	383.08	768.73	459.11	360.60	0	91.19	3632.48	118.77	103.35
- S. Peel	344392.18	121476.11	12130.85	5091.47	23032.96	24710.44	7405.82	8733.61	17513.50	114328.70	8773.47	1195.25
Total	598126.11	197459.73	20388.07	11024.04	48159.44	7771.31	13417.51	9918.04	26242.31	226050.47	11428.31	1804.54
Stratford	76159.07	44491.20	1285.16	0	8767.92	2233.22	3833.35	644.96	3205.44	10689.69	694.29	313.84
Tillsonburg	30605.11	14580.51	0	808.76	4612.49	1430.70	1286.57	949.72	2457.52	4067.19	192.00	219.65
Waterdown	11294.85	5825.31	0	0	1847.68	220.50	594.14	118.50	514.26	1680.12	132.24	362.10
Waterloo	152659.35	57293.30	1416.40	2265.30	32812.23	6121.49	5148.39	4973.06	4638.68	36681.58	0	1308.92
TRICKLING FILTER												
Frankford	9195.85	5368.42	924.38	0	546.36	264.60	423.77	93.08	471.74	693.47	0	410.03

*NOTE: Costs listed for the Brampton/Chinguacousy, Lakeview and Streetsville plants are for the first six months of 1969. Those listed under South Peel are for all the plants in the project in the latter part of the year.

TABLE XV UNIT OPERATING COSTS

PROJECT	TOTAL OPERATING COST $	UNIT OPERATING COSTS			TOTAL SLUDGE HAULAGE COST $	UNIT SLUDGE HAULAGE COSTS		TYPE OF SLUDGE
		$/mil gal	¢/lb BOD removed	¢/lb SS removed		$/yd	$/ton solids	
PRIMARY TREATMENT PLANTS								
Belleville	82,403.67	42.68	9.1	6.2	1631	0.60	10.3	Liquid Digested
Cornwall	111,464.51	44.03	22.0	5.4	2693	1.50	14.8	" "
Espanola	13,750.84	409.49	27.0	34.1	9498	1.60	-	" "
Fort Erie	34,664.71	58.16	23.3	8.7	1070	0.85	24.9	" "
Fort Frances	38,741.52	55.92	13.3	10.2	2887	2.83	-	" "
Midland	35,187.35	72.11	25.8	5.8	3289	1.40	12.8	" "
Owen Sound	53,549.66	36.30	5.4	1.9	10249	0.99	16.1	" "
Parry Sound	33,021.33	126.66	29.5	12.8	nil	-	-	" "
Point Edward	17,289.69	222.32	34.7	11.6	644	1.20	30.7	" "
Port Dover	27,326.42	208.42	12.2	9.9	nil	-	-	Vac. Filtered, Raw
Sault Ste. Marie	146,194.04	46.22	11.3	7.6	9499	1.60	-	" "
Thunder Bay North	63,095.36	36.76	4.7	4.1	4305	0.80	11.9	Liquid Digested
Thunder Bay South	83,863.21	46.60	7.6	7.2	2290	0.80	6.5	" "
Timmins	59,394.86	56.57	3.1	1.9	14216	1.15	23.5	" "
Trenton	28,799.25	36.84	5.3	2.7	nil	-	-	" "
EXTENDED AERATION PLANTS								
Burlington Sky.	80,952.25	66.46	4.6	3.8	7539	0.55	-	Liquid Raw
Elora	5,743.38	210.64	15.3	8.1	nil	-	-	" "
Moore Twp.	16,333.25	364.50	21.7	24.6	544	1.40	-	Liquid Raw
Moosonee	7,976.69	550.88	59.8	39.3	nil	-	-	Liquid Digested
Paris	8,004.03	81.84	4.4	7.9	524	-	-	Liquid Raw
Westminster Twp.	17,264.18	136.53	16.3	8.8	520	-	-	" "
CONTACT STABILIZATION PLANTS								
Haileybury	16,738.90	135.44	14.2	7.9	nil	-	-	Liquid Digested
CONVENTIONAL ACTIVATED SLUDGE PLANTS								
Brantford	254,678.50	91.55	5.5	3.8	3470	-	-	Vac. Filtered, Digested
					17114	-	6.7	Liquid Digested
Burlington D. L.	42,152.71	70.86	3.5	2.5	5425	0.55	-	" "
Burlington E. G.	28,721.33	73.59	6.2	5.4	7662	0.55	55.5	" "
Chatham	149,745.68	100.23	3.6	4.2	8840	0.68	9.2	" "
Coniston	18,073.73	257.43	13.0	21.5	nil	-	-	Dried Digested
Elmira	41,145.28	212.42	6.0	25.0	2012	1.00	-	Liquid Raw
Fergus	25,448.57	108.11	9.8	5.8	4517	1.00	115.8	Liquid Digested
Galt	94,613.16	43.35	3.5	3.4	10829	0.90	23.5	" "
Georgetown	48,582.44	122.61	7.4	8.1	10793	1.00	-	" "
Huntsville	14,072.02	135.44	9.7	9.9	1473	1.00	28.2	" "
Kingston Twp.	39,254.02	113.78	3.1	2.3	942	.62 ~~2.80~~	-	" "
Kitchener	275,557.76	70.88	3.0	2.6	45676	0.85	15.1	" "
Markham	29.098.52	135.27	9.1	7.0	2678	~~7.00~~ 1.18	24.6	" "
Nepean Twp.	71,457.17	91.89	15.3	6.5	nil	-	-	" "
Newmarket/E. G.	56,884.48	92.93	4.9	3.2	6228	0.90	19.0	Liquid Digested
North Bay	121,522.69	68.38	6.4	4.6	24056	0.80	16.0	" "
Orangeville	26,579.37	98.01	7.4	5.5	1678	1.50	-	" "
Pickering	18,659.35	923.75	46.0	30.2	nil	-	-	" "
Port Colborne	97,206.18	100.88	11.5	7.8	8429	0.85	90.6	Liquid Digested
Preston	62,603.47	130.61	2.2	1.2	12981	0.95	-	Vac. Filtered, Raw
						1.65	-	Liquid Raw
Richmond Hill	60,794.64	78.98	6.8	4.8	11734	0.93	17.5	Liquid Digested
Sidney Twp.	9,314.82	78.46	31.4	28.0	nil	-	-	" "
Simcoe	50,722.79	78.34	3.7	4.4	nil	-	-	" "
Stratford	76,159.07	57.59	5.5	3.6	8905	0.72	13.0	" "
Tillsonburg	30.605.11	142.61	7.0	5.3	3223	0.90	43.6	" "
Waterdown	11,294.85	513.40	15.4	14.8	1142	-	-	" "
Waterloo	15,265.35	-	-	-	26483	0.90	25.3	" "
South Peel:								
- Brampton/C.	74,964.81a	-	-	-	20712	1.00	28.4	" "
- Lakeview	167,708.37a	-	-	-	140873	1.25	28.2	" "
- Streetsville	11,061.75a	-	-	-	1199	1.15	-	" "
South Peel	344,392.18b	-	-	-	nil	-	-	" "
TRICKLING FILTER PLANTS								
Frankford	9,195.85	174.96	22.4	19.0	nil	-	-	Liquid Raw

NOTE:
a Cost of operation January - June 1969
b Cost of operation June - December 1969

Date Due

APR 15 1971

TD
367
.A56
O97
1969

Ontario Water Resources Commission : water pollution control plants.

81556

Environment Ontario
Laboratory Library
125 Resources Rd.
Etobicoke, Ontario M9P 3V6
Canada

LABORATORY & RESEARCH LIBRARY
MINISTRY OF THE ENVIRONMENT

Water management in Ontario